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The Hall Air Compressors.

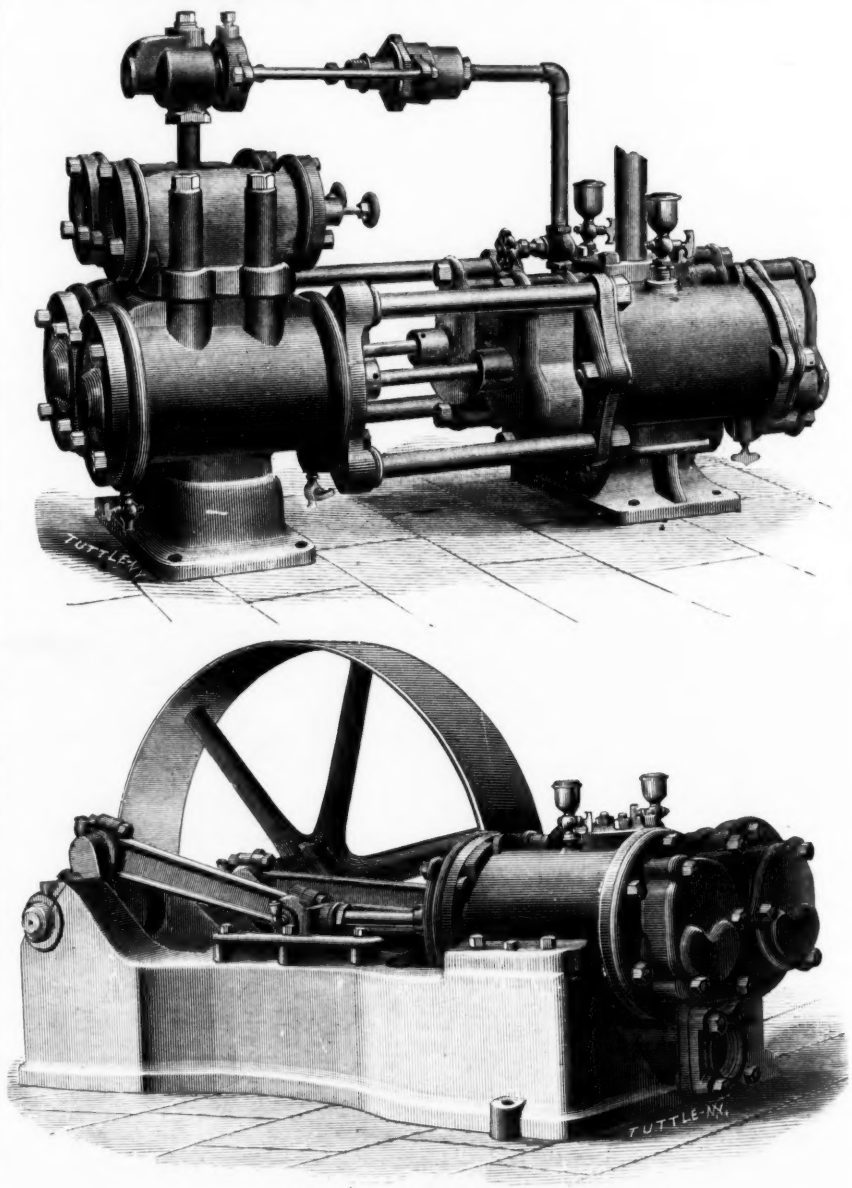
Our illustrations on this page are of two forms of air compressors, built by the Hall Steam Pump Co., 91 Liberty street, New York city.

Both the machines are duplex, one being driven by a belt, the other by steam direct, the valves and steam end arrangements generally being the same as are used on the steam pumps built by the same company, and which have been fully described in these columns.

The construction of the suction and delivery valves is shown by the detail cuts, Fig. 1 being a view of the valves separately, and Fig. 2 a view of part of the air cylinder with a section of the plate in which the valves are fixed. These valves and their arrangement are the same in each machine.

The steam valves used in the Hall pump have been found to be well adapted to use in air compressors, for the reason that the length of stroke of the pistons is practically the same under all ordinary variations of load or steam pressure, thus allowing of the employment of much smaller clearance spaces than could otherwise be used, which, of course, for air compressor work, is vitally important. The character of the mechanism also admits of the comparatively high speeds necessary for this work. An automatic regulator is provided, which can be adjusted to maintain any desired air pressure. It operates to open or close a valve in the steam pipe, the motion for this being obtained from a piston which is moved by slight variations of air pressure.

For small volume, and pressures up to about 25 pounds, these compressors have proven very satisfactory, and work with very good economy; the size which can be economically employed depending somewhat, of course, upon the cost of fuel in the locality where used—the most used sizes being with steam cylinders 5″ to 15″ diameter, and with air cylinders a little larger. Many of these are used for furnishing air blast in burning oil as fuel.



THE HALL AIR COMPRESSOR.

Closing Words Upon Tapers—Werner Fears that a Uniform Standard would Destroy "Individuality."

BY JARNO.

It can hardly be expected that we can, in practice, fit a tenon so tight in its key-hole that the arbor cannot slip. The idea of having a tenon prevent the arbor's slipping is well enough for a milling machine cutter arbor, as any slipping that may come from looseness between the tenon and the key-hole does not, necessarily, do any injury. In a gear cutting machine, to have the gear arbor slip in the least may cause the gear to be spoiled. It is usually expected that mediumsized and small gear arbors, when simply driven in, will be kept from slipping by the friction of their shanks in the spindle holes. The largest milling or gear arbor is held in by a bolt going through the spindle lengthwise, and into a threaded hole in the end of the arbor. No. 15 shank, 1.5″ diameter at the small end, I would call medium size; No. 20, 2″ diameter at the small end, I would call large. When the arbor is held in by a bolt, there need be no key-hole through the spindle, as the bolt acts also to drive out the arbor. Gascon thinks that it is never safe to depend upon simply the friction of the sides of a shank to hold an end mill in its collet, and that a tenon is more dangerous than no tenon, because, if a mill that has a tenon works loose, it continues to turn for a time, and may dig into the work. This appears like putting it rather strongly after so many years' use of such mills, but the same opinion obtains among tool makers, for I see in a late catalogue that some end mills are threaded in place of a tenon, the thread running up from the end about the length of a tenon. Even a threaded shank end mill may work loose, but not so soon as one that has simply a tenon. With either kind it makes a great difference as to how the shank fits into the spindle or collet. Too much attention cannot well be given to making a good fit. If the shank be at all loose at the outer end, the slightest vibration that it must then take will cause it to work out. I have great faith in the ability of vibrations to find defects.

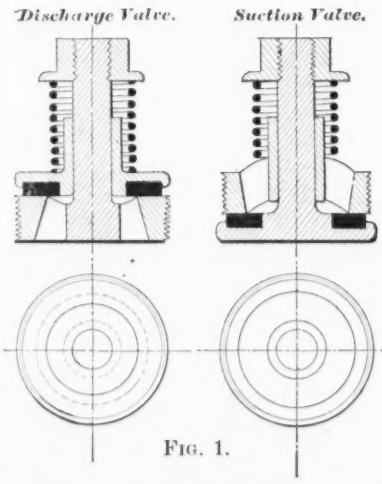


FIG. 1.

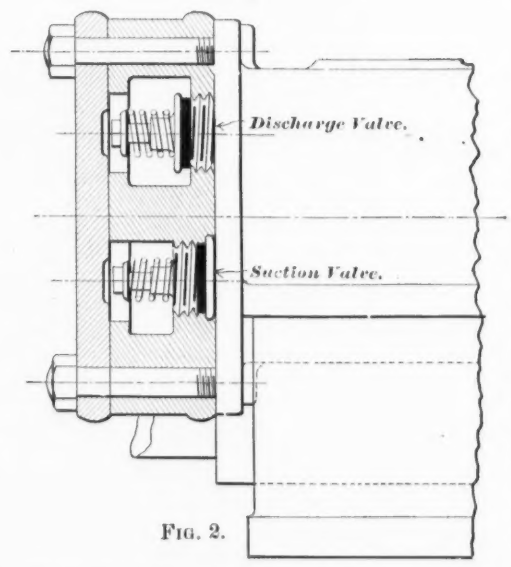


FIG. 2.

It is sometimes a convenience to have the shank of the live center like that of the foot-stock center, so that, if the live center be used in the foot-stock spindle, it can be driven out by the screw. This had not been attended to in two lathes that lately came into Gascon's shop.

In the production of interchangeable parts, machine tool makers are not quite abreast of some other workers in metals. Machine tool makers have standard size gauges, they have standard thread gauges in order to duplicate or replace parts of their own machines. This is well; in fact, it is almost a necessity. But it would be another and a greater thing to have some of the machine tool parts from one maker to interchange with those of every other maker. The next step in mechanical progress should bring us to a uniform rate and sizes of taper. To make over lathe spindles so as to have the centers interchange may be better than to have so many different tapers; but better still it is to manufacture lathes so that they shall not have to be made over. As regards spindle holes, a lathe maker may be excused if he does the same thing that all his neighbors are doing, if they adopt a standard.

Different watch factories make movements that will fit the same case. Microscope objectives bought in any city in America will interchange with others made wherever English is the ruling language. Gas burners are interchangeable. To attempt to make them other than of the established thread and size would be to place a ban upon the enterprise.

Werner says: "Your center reform would be one of the things that tend to destroy individuality, which would cause us to drift backward, and progress to come to an end."

I reply: "When one does not wish to change out of an old way, it is any contemned thing, but make the change; even a mare's nest will answer for a clog. Has any one ever known a superabundance of individuality? I do not think it would be possible to teach two persons even to write alike. On my way to the shop, this morning, as I came to the railway crossing, a freight train blocked the foot-way. I looked into the retarded faces and noted the expressions both visible and audible. Some swore while others smiled, some grunted while others were silent. One man took a paper out of his pocket and read. Now, how much better all this is than if there had been no individuality! In the same circumstances I suppose you would object to having every person smile or read the AMERICAN MACHINIST."

"Your story of the belated foot passengers is interesting enough as a study, but, like 'the flowers that bloom in the spring time,' it has little to do with the case. Improvements in machinery do come from individuality. If an association settles upon a certain size for a machine part, and every

machinist follow, then the association does to progress what the freight train did to your foot passengers."

I rejoin that there cannot be more danger from having standard tapers than from standard threads in microscopes and gas fixtures.

Will machinists adopt a standard taper? Perhaps the question should be, shall they adopt? A few years ago it was proposed to set many thousand clocks and watches so that they should indicate what is now called standard time. From the many questions asked and objections raised, the change seemed difficult and impracticable. Yet we were ready, the change was made; in a few days it was not noticed as giving any inconvenience. At about the same time there was a proposition to have the hours numbered up to twenty-four; among other reasons, so that, in speaking of any hour, it would not be necessary to tell what kind of an hour was meant. Many persons had their watch dials arranged to count hours above twelve. Clock manufacturers made thousands of clocks geared to turn the hour hand around once a day, and having dials figured from one to twenty-four. That the proposed way of counting would have some advantages was generally admitted. It was said to be better for scientific reasons. Acquaintances pleasantly told each other the time in the new way: "It is now half past thirteen o'clock," or, "It is now seventeen o'clock." Yet this change was not made. We were not ready.

Some things are done from reason, and others from feeling or enthusiasm. However reasonable it may be, if we do not feel like doing it, the thing is not likely to be done. Sometimes I am not surprised that men have supposed their feelings to be influenced not through their reason, but by something not themselves. And so I may say that, if I have succeeded in pleasing the genius that controls the feelings of machinists at the present hour, we shall soon have a standard rate and standard sizes of tapers but if the genius frown, we must wait.

In account with the world, we as machinists have a certain amount of work to do. The world will excuse us when this work is done, even though we do it in fewer hours than formerly. We want more time for social and intellectual improvement. I have that faith in the order of things to believe that, when we deserve this time, to us it will be given. Anything that saves time should, at last, save it for us all.

Modern Locomotive Construction.

BY J. G. A. MEYER.

LAST PAPER.

Figs. 613, 614 show a portion of the sectional elevation and plan of a narrow gauge mogul locomotive. It will be noticed that there is not an equalizing lever between the front and central driving wheel springs. This arrangement divides the spring gear into two distinct parts. The rear part is similar to that described in the foregoing paper; the front part consist of a system of equalizing levers connecting the front driving wheel springs to the two-wheeled, or pony truck springs. The front spring hangers P_7 connect the springs to the transverse equalizing lever D; the longitudinal equalizing lever A is placed midway between the frames; it works on the fulcrum pin B held in the casting C bolted to the underside of the cylinder saddle; the rear end of the lever A is connected to the transverse lever D by means of the link E; the front end of the lever A takes hold of the king bolt in the pony truck, which is not shown here.

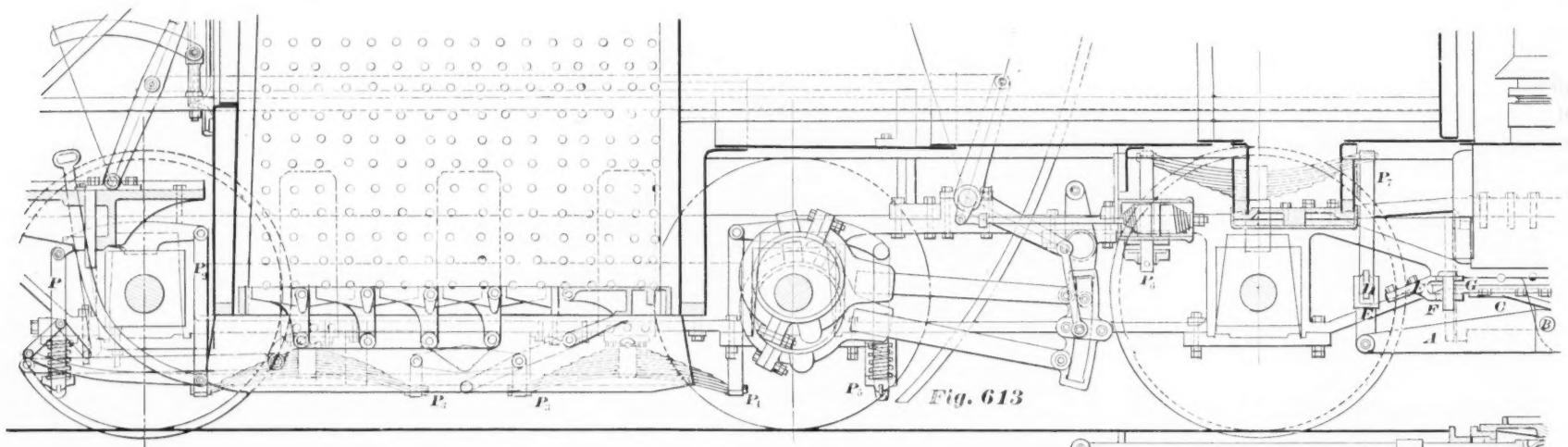


Fig. 613

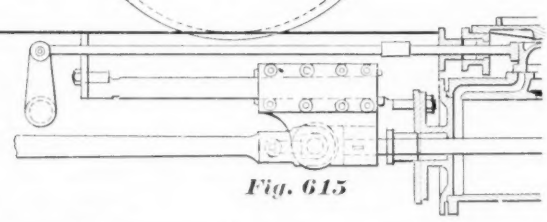


Fig. 615

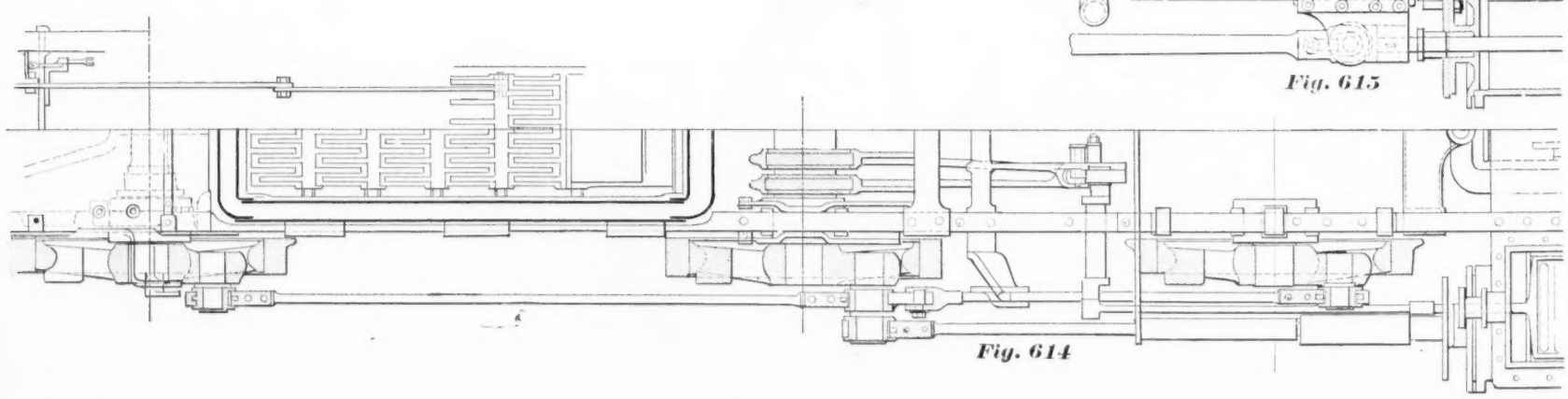


Fig. 614

In wide gauge mogul engines the design of the front part of the spring gear is similar to the one here shown; but at the rear end, the springs are generally placed above the frames over the driving wheel boxes, and connected by equalizing levers as shown in Fig. 599, making the design of the rear part of the spring gear similar in all respects to that of a driving wheel spring gear for a four-wheeled passenger engine.

In consolidation engines the springs over the second, third and fourth driving axle are generally connected by equalizing levers, forming a system similar to the design of the driving wheel spring gear in a ten-wheeled engine. The front driving wheel springs are connected to the pony truck by a system of levers like those used for a mogul engine.

In eight-wheeled passenger engines, and mogul engines, having spring gears as here described, the mass of machinery supported by all the spring has three main points of support; two of these points are at the rear end, and the other at the front. In both classes of engines the rear points of support are the fulcrums of the main equalizing levers midway between the two rear driving wheels. In passenger engines, the truck center pin forms the front point of support; and in mogul engines, the fulcrum of the equalizing lever which connects the front springs and the pony truck forms the front point of support. Ten-wheeled engines, and consolidation engines with spring gears as here described, have five main points of support; the fulcrums of the equalizing levers connecting the driving wheel springs form the four main rear points of support. In a ten-wheeled engine the front point of support is formed by the truck center pin; and in the consolidation engine, the fulcrum of the equalizing lever connecting the front driving wheel springs and the pony truck performs the same office.

The center of gravity of a passenger engine will always be between the three points of support, as it should be, in order to make the engine ride steadily. The center of gravity of ten-wheeled, mogul and consolidation engines should always lie between the front point of support and the two points —one on each side of the engine—lying midway between those driving wheel springs which are connected by equalizing levers. There is danger of changing this condition; for instance, if in mogul engines all the driving wheel springs are connected by equalizing levers, the center of gravity may be on the rear of the points just referred to, instead of lying between these points and the front point of support; the consequence will be that the rear end of the engine will have a constant tendency to drag downwards, and interfere with the steady riding of the engine. The same remarks apply to consolidation engines. Here, then, we perceive the reason for not having equalizing levers between the front springs and the adjacent ones. There is another advantage gained with this arrangement. When the pony truck wheels pass over any unevenness of the track, or obstacles, the truck springs will be relieved of some of the strain, a portion of it being thrown on the front driving wheel springs. In these papers we have endeavored to describe thoroughly some of the principal parts of the locomotive. The boilers, trucks, tenders, etc., will be treated in a similar way, and will soon appear with all the foregoing papers in book form.

The Massachusetts Institute of Technology is using the papers on "Modern Locomotive Construction," written by J. G. A. Meyer, as a text for instruction for the students.

There is still great distrust in England of copper steam pipes for steamships; winding them with wire is now recommended.

The Performance of a Double-Screw Ferryboat.

The above is the title of a paper, which we abstract below, presented by E. A. Stevens and J. E. Denton at the twentieth meeting of the American Society of Mechanical Engineers.

In the introduction of the paper, Mr. E. A. Stevens briefly referred to the design of the first ferryboat, also to the advancement made in the construction of these boats, and gave some of the considerations which led to the adoption of the plan of the boat "Bergen," whose performances, and a comparison of the same with that of the boat "Orange," was the subject of this paper. In referring to the service demanded of a New York ferryboat, he said:

The weight of the loads carried, both in passengers and teams, as well as the strain caused by the ice and the danger of collision, all call for a hull of great strength and rigidity. Beyond this, the vessel must have great stability, to resist burying by the head as well as heeling. She must be able in floating ice, and should attain a speed of about twelve miles an hour in service. The main characteristics of the Bergen's model are a full flaring upper body, fine under water body, with a full water line, a sharp V-shape midship section, and the peculiar cutting away of the ends to bring the rudders and screw within the perpendicular of the stems.

The shape of the water lines and upper body were determined by consideration of power in ice and stability.

The midship section, in order to give an unbroken line for the shafting, had to have a certain depth. It was found that, with the required displacement, the form adopted was about the only practical one. The experience on the Hoboken ferry, moreover, had been very favorable to a sharp V section. The older, wooden boats, built on a perfect V section, gave excellent results, while on the iron and steel boats, the Orange and Montclair, which more closely approach that section, gave better results than the other boats which had a semi-circular section and, as far as could be judged, than the West Shore and Pennsylvania R. R. ferryboats, with straight sides and a flat floor.

The experience on the Hoboken ferry, with balanced rudders hung under the keel and supported from above, having been very favorable, both as regards efficiency, strength and ease of repair, it was decided to use a rudder as nearly similar to the ones in use as

conditions would allow. The form with the ends of the rudder stock supported in the shoe appeared most suitable, and the fixed rudder in the bow seemed to promise protection from ice to the forward screw.

The following are the principal dimensions of the ferryboats Bergen, Orange and Moonachie:

	Bergen.	Orange.	Moonachie.
Built	1889	1887	1877
Hull	Steel.	Steel.	Wood
Engine, Type	Triple Expan. Propeller.	Low-Pressure Beam.	Low-Pressure Beam.
Size	18½", 27" and 42"x27".	46"x10'	44"x10'
Safety Valve Pressure—lbs. per sq. inch	160	45	30
Length, L.W.L.—Feet	200	217	200
Beam, L.W.L.—Feet	32.16	32	32
Beam, over guards—Feet	62	62	62
Draught—Hull to Base Line	8.83	7.66	8
Displacement to L.W.L.—Tons	560	655	550
Displacement per inch at L.W.L.	12.6	.....	.....
Space available for Pass.—Sq. Feet	4,330	3,791	3,335
Space available - Number of Seats	296	254	236
Space available for Teams—Sq. Feet	3,448	3,940	3,380

The engines for the Bergen are illustrated in our issue of November 24, 1888.

The following are the results of experiments to determine the performance of the Bergen, given by Prof. J. E. Denton:

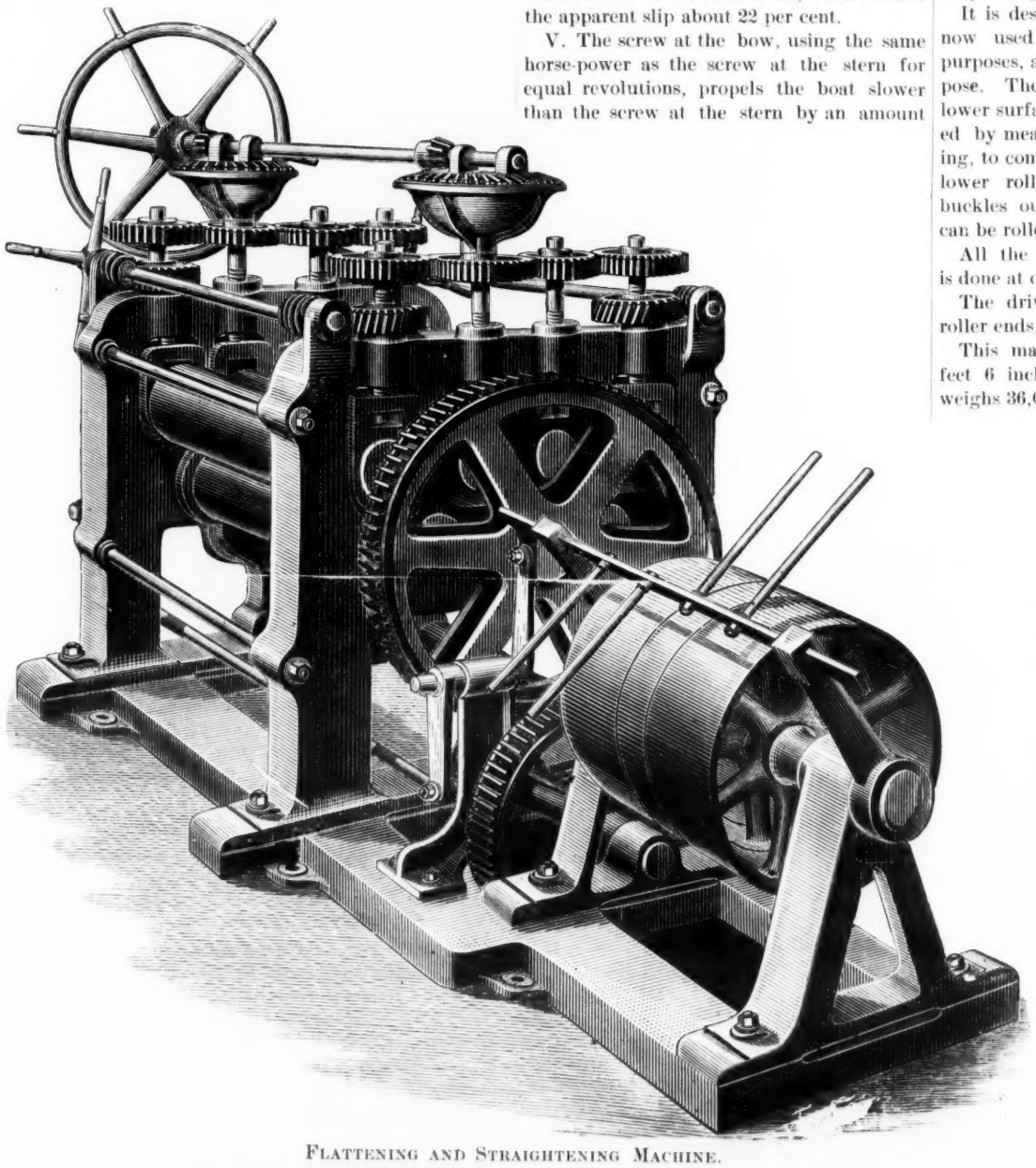
The objects of the experiments undertaken were to determine the relative economy of the Bergen, as compared to the best type of paddle-wheel ferryboat having the common style of overhead beam engine, a jet condenser and drop-return flue boilers. The paddle boat selected for this purpose was the Orange, one of a pair of steel boats designed in 1887, by Mr. Francis B. Stevens, and representing the best modern example of its class of ferryboats. The programme carried out was as follows:

I. The steam consumption, boiler evaporation, horse-power and speed were determined for each boat during 14 hours of regular ferry service.

II. Each was run to Newburgh and return, a distance of 120 miles, without stoppage, and the steam consumption per horse-power determined at the maximum capacity of the boilers. Also the evaporative economy of the boilers, starting with new wood fires, was determined during an interval of 14 hours, and the speed was measured by an estimate of the probable velocity of tides, and a log whose correction co-efficient was approximately known.

III. The speed of the Bergen was determined at the maximum horse-power for which the engines were designed, by opposite runs over a one-mile course, after allowing the boiler pressure to accumulate above the average pressure which the boilers can maintain for more than a few minutes.

IV. One of the screws of the Bergen was removed, and the power and speed determined by runs over a two-mile course, first with the single screw pushing, and then with it pulling the boat at equal speeds of revolution of the engine.

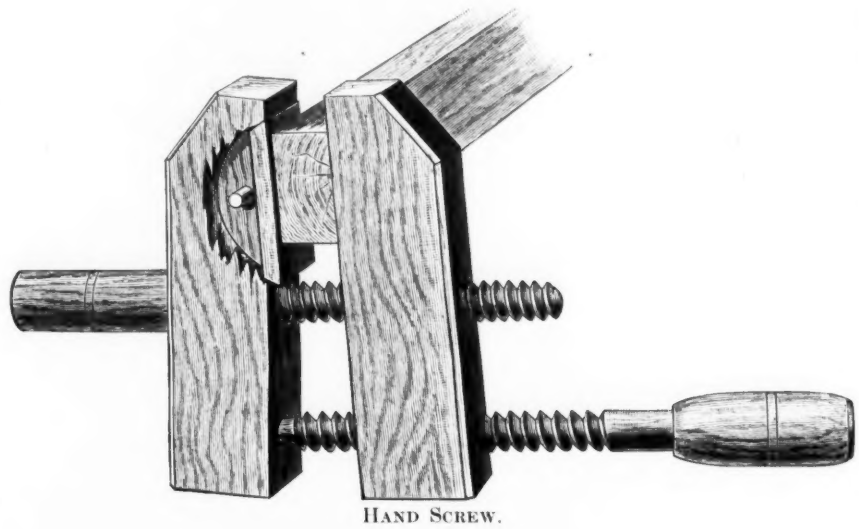


FLATTENING AND STRAIGHTENING MACHINE.

CONCLUSIONS.

The principal conclusions drawn from the experiments are as follows:

I. The steam used per horse-power for all purposes is 25 pounds per hour for the beam engine, and 22 pounds for the triple engine, under their average conditions of ferry service, but the consumption of the Bergen's main engine is only 18.3 pounds per hour per H.P., the direct-acting steam feed and circulating pumps, etc., consuming about 3¾ pounds per indicated horse power.



HAND SCREW.

II. The steam consumption of both engines does not sensibly differ while in intermittent ferry service, from that found during continuous working of the engines.

III. The economy of the drop-return flue boiler of the Orange is practically the same as the locomotive type in the Bergen, both boilers evaporating on the average about 8½ pounds of water per pound of bituminous coal, under ordinary working conditions, thus making the consumption of coal per hour per H. P. about 2.9 for the beam engine 2.6 pounds for the Bergen, for all purposes, and 2.15 pounds for main engines alone.

IV. The speed of the boats under all conditions is practically in agreement with the law of cubes, and by the application of this law it appears that, for a still-water speed of 12.6 statute miles per hour, the following statements are practically true: The paddle-wheel boat would require 642 H.P., and would make 24½ revolutions per minute with a slip of 26 per cent.

The screw boat, using double screws, would require 680 H. P., an engine speed of 145 revolutions, and the slip would be 12½ per cent.

The screw boat, using one screw at the stern, would require 584 H. P., 152 revolutions per minute, and the slip would be 18 per cent.

The screw boat, using one screw at the bow, would require 692 H. P., 163 revolutions per minute, and the slip would be 18 per cent., but the recoil upon the hull, of the water which the screw acts on, would make the apparent slip about 22 per cent.

V. The screw at the bow, using the same horse-power as the screw at the stern for equal revolutions, propels the boat slower than the screw at the stern by an amount practically equal to the equivalent of the extra resistance due to the increase of the velocity of the boat by an amount equal to the velocity of slip of the screw.

VI. By calculations based upon the accepted relations between the slip of the screw and the velocity of a boat, it appears that, in order for the double screws to produce the same speed as a single screw of the same diameter at the stern, the slip of the latter must be to the former in the ratio of 18 to 11, and therefore the cause of the extra power consumed by the two screws as compared to the one screw is the fact that the slips are as 18 to 12.6, instead of as 18 to 11.

Whether use in heavy ice will show any defects that may require modification is as yet an unsettled question. Practically the Bergen is preferred by passengers and pilots alike.

Self-Adjusting Hand Screws.

With this we give an illustration of an improvement in hand-screws by which the bearing of the clamp upon the work is always made uniform and even, whether the clamps be tightened up exactly parallel or not. This is accomplished by letting into one of the jaws a self-adjusting piece of the shape shown, which has a bearing in the jaw over its entire surface at the back, the pin serving simply to hold the piece in place when handling the clamps.

The improvement, while it does away with some of the most objectionable features of hand-screws, does not change the method of handling them, and it is claimed makes them less liable to breakage as the necessary strain on the screws and jaws is reduced. They are made with jaws of beech and maple and with screws of hickory, in seven different sizes, by W. H. Denney, Lancaster, Pa.

Seven Roller Flattening and Straightening Machine.

We illustrate with this a plate-working machine, made by Rushworth & Co., Sowerby Bridge, Yorkshire, England.

It is designed for use on the heavy plate now used in shipbuilding and for other purposes, and is strongly made for this purpose. The rolls are so arranged that the lower surface of the top rolls can be adjusted by means of the hand-wheels and gearing, to come below the upper surface of the lower rolls, for the purpose of taking the buckles out of the plate; then the plates can be rolled so as to come out quite straight.

All the adjustment of rolls and reversing is done at one end of the machine.

The driving roller, as well as pinions on roller ends, are of steel.

This machine will handle plates up to 5 feet 6 inches wide by ¾ inch thick, and weighs 36,000 pounds.

A Good Plan.

The following, taken from *The Crank*, of Sibley College, Cornell University, contains a hint which might prove valuable to associations of mechanics:

A number of seniors have formed themselves into a seminary for the purpose of reading and discussing the periodicals on file in the Sibley reading-room. The plan of operation is as follows. To each member is assigned a paper which he is to read carefully previous to the meeting, noting such articles as he may deem the most important. He then presents an informal report at the meeting, stating the leading features and facts of these articles, together with such comments as he may wish to make, at the conclusion of which a general discussion takes place. Meetings are held every Monday evening in the Sibley reading-room, and so far have been well attended. A number of the professors and instructors take an active part in the work of the seminary, and the indications are that the scheme will be of great value to those participating in it.

Nothing gives one so clear an idea of a subject as to study it especially with a view to talking or writing about it, particularly where it is done with the expectation that criticism and free discussion will follow.

It appears that nearly one-half the strikes in manufacturing countries are for an increase of wages.

Indexing by Differential Movements.

BY FRED J. MILLER.

In cutting teeth in angular cutters, or doing similar work on the Brown & Sharpe universal milling machine, it is noticed that if the angle of elevation of the spiral head spindle be changed during the progress of the work, the cutter seems to no longer match exactly with the cuts that have been taken, and the work must be rotated slightly to bring things just right again. This is caused by the fact that when the spindle is elevated or depressed the worm-wheel is rotated about the worm, which is held still, and of course the same effect is produced as though the worm were turned to the same extent in the opposite direction. To correct the error thus introduced sometimes requires a smaller movement of the index-pin than is provided for in the regular way.

This led me to secure a finer movement by moving the index-plate one way a definite number of holes and then moving the regular index-pin in the opposite direction over the same number of holes, but of course in a different circle of holes. This gives to the worm what may be called a differential movement, the value of which is equal to the difference between the two opposite movements composing it. This of course naturally led to figuring the value of the resultant movement, and to the discovery of a method of indexing, which, besides possessing some very interesting features, enabled me to index numbers which would have been impossible by the ordinary method. I constructed a table showing part of the divisions possible by the new method, and used it on many occasions. To make the matter plain, we will suppose that the pin which engages with the index-plate at the back, and ordinarily holds it still, is in one of the holes of the 47 circle, and that the regular index-pin is in the 49 circle. Now if the first mentioned pin be pushed back, the plate turned one hole and the pin shoved in again, it is evident that the plate has been turned $\frac{1}{47}$ of a turn, and has carried the regular index-pin and worm with it; now, if this pin be moved one hole in the opposite direction, the worm will be turned $\frac{1}{49}$ of a turn, and the result of the two motions will be the difference between $\frac{1}{47}$ and $\frac{1}{49}$, which is $\frac{2}{2303}$, and this fraction divided by 40 (the number of teeth in the worm-wheel) gives $\frac{1}{46060}$ as the fraction of a turn given to the spindle. This number (46,060) is, with the plates provided, the greatest number which can be indexed by the machine, and it will be conceded, I think, that it is enough for all practical purposes. Of course two holes each way would give half as many, or 23,030, and so on, ten holes each way giving 4,606 divisions. For lack of room I cannot give the complete table here, but, as illustrating its range, give below that part of it which gives the divisions obtained by a combination of the two circles having 20 and 18 holes, choosing this because it happens to give divisions which correspond to certain numbers of minutes of arc, as given in the last column.

CIRCLES 20 AND 18.

No. of Holes Taken in Each Circle.	Division.	Angular Movement.
1	7,200	3′
2	3,600	6′
3	2,400	9′
4	1,800	12′
5	1,440	15′
6	1,200	18′
8	900	24′
9	800	27′
10	720	30′
12	600	36′
15	480	45′
16	450	48′
18	400	54′
20	360	1°

It will be noticed that the last division (360 or 1°) is obtained by moving the pin just one revolution one way, and one revolution plus two holes—or $\frac{19}{18}$ revolutions—the other way, and it is evident that the same result is obtained if the whole revolution each way be omitted, and a simple movement of two holes in the 18 circle be given. Wherever either a whole turn or any equal fraction of a turn can be taken from each movement, the operation of dividing is facilitated. In the table given, for instance, all the divisions calling for 10 or more holes each way can be shortened in practice by taking $\frac{1}{2}$ turn from the movement in each direction. Ten holes in the 20 circle is of course just half a revolution, and ten holes in the 18 circle is half a revolution plus one hole; taking away the half revolution in each direction, the result is a simple movement of one hole in the 18 circle to get the same result as would be obtained by moving 18 holes in each circle. All of them do not reduce to quite so simple a form, however, though all below the eight hole division can be much shortened. For instance, where 16 holes are required for a division of 450 one-half revolution taken from each movement leaves a movement of 6 holes in the 20 circle and 7 holes in the 18 circle. Half of the 18 circle being 9 holes, and 9 holes being one less than one-half of 20, the movement of one hole in the 20 circle will give the same movement as 9 holes in each circle. From this it will be evident that all the movements below that of 8 holes in each direction may be changed to those given in the second table, where the movements from 9 to 20 holes each way are given, with their equivalents, taking the smallest possible movement in each circle. Where the whole number of holes in each circle is divisible by any one number, it is evident that the fraction of a turn which is the reciprocal of that number can be taken from each movement wherever it occurs in both. For instance, if we were using the circles having 33 and 27 holes, both these numbers are divisible by 3, the reciprocal of which is $\frac{1}{3}$, the fraction of a revolution which can be taken from both whenever it occurs in both. Using these two circles, a movement of one hole each way would give a division of 5,940, and 12 holes each way would give a division of $\frac{1}{12}$ of this, or 495. More than a third of a revolution each way is called for here, and taking that fraction of a revolution from each there is left a movement of one hole in the 33 circle, and 3 holes in the 27 circle, which gives the same result, or 495.

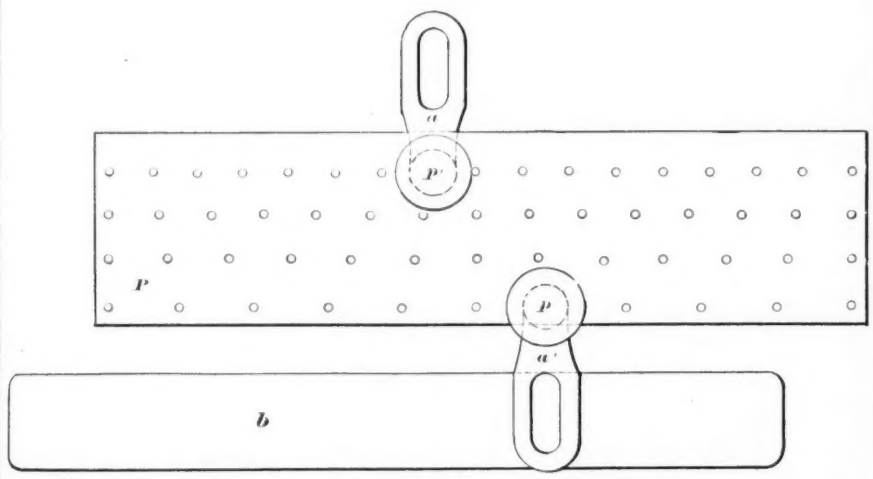


FIG. 2.

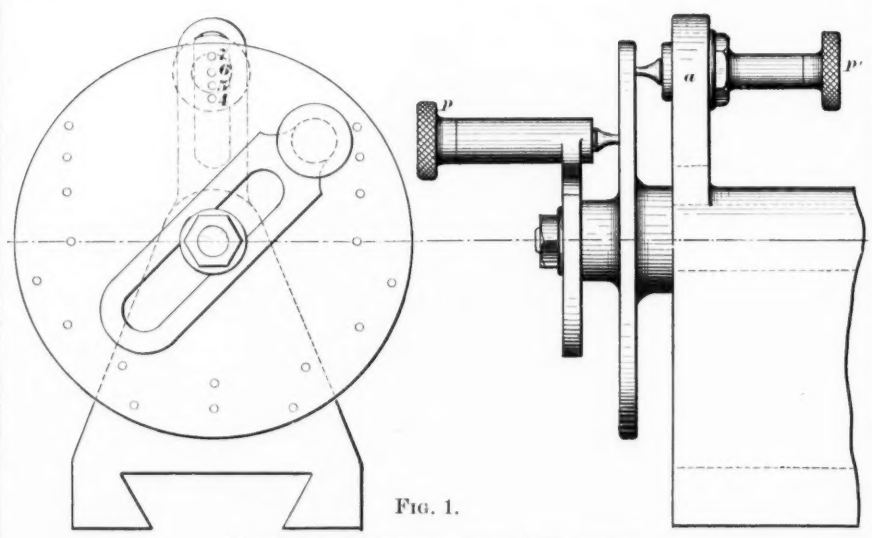


FIG. 1.

INDEXING BY DIFFERENTIAL MOVEMENTS.

No. of Holes Taken in Each circle.	Equivalent Movements.		Division.
	20 Circle.	18 Circle.	
9	1		800
10		1	720
12	2	3	600
15	5	6	480
16	6	7	450
18	8	9	400
20		2	360

The fraction representing the movement of the spindle, must, when reduced to its lowest terms, have a numerator of unity, and when a fraction will not reduce to this form it is unavailable, though this applies to the spindle, and not necessarily to the index-pin. That is to say, the fraction of a revolution imparted to the index-pin may not be reducible so that the numerator is unity, but if it is so reducible after being divided by 40, which is the fraction of a revolution given the spindle, then it becomes a practicable division. Lack of space only prevents carrying out the tables to much greater movements or their equivalents, and thus getting divisions of smaller numbers which are not provided for in the ordinary way. As an instance of what may be done in this way, take the last case mentioned, where the equivalent of 12 holes each in the 33 and 27 circles gives a division of 495. If 5 times 12, or 60 holes, be taken in each circle, it is evident we shall index a number equal to one-fifth of 495, which is 99. But instead of taking 60 holes, in each circle, we can subtract from each movement one and two-third turns as explained above, and this leaves a movement of 15 holes in the 27 circle, and 5 holes in the 33 circle, to secure the same result.

In the AMERICAN MACHINIST of Oct. 31 Mr. Walter Gribben referred to this method of dividing, but gave no explanation of his method of computing the different movements. Perceiving that his method was probably different from mine, I asked him to give us a full explanation of it, in response to which he contributes the admirable article found elsewhere in this issue. It will be perceived that, up to the point of separating the numbers into their prime factors, the two methods are really equivalent one to the other; Mr. Gribben's being the algebraic, while mine is the arithmetical method of arriving at the same result. His plan of factoring, however, is a valuable feature, and very much reduces the labor necessary to find whether or not a given number can be indexed. On the other hand the plan of taking out from each movement equal fractions of a turn as well as whole turns, considerably reduces the labor of indexing in many cases after the given number has been found to be possible to divide. The difference is seen when the movement given by Mr. Gribben for indexing 99 is compared with the movement given above for the same number; Mr. Gribben's being one turn and 6 holes in the 27 circle and 27 holes in the 33 circle; while mine for the same division is 15 holes in the 27 circle and 5 holes in the 33 circle. The computation of a complete table showing all the divisions which can be made in this way would involve considerable labor, and would require more space than could be given it here, but, with the explanation of the two methods given, it ought to be easy for most any one to get any possible division, though it is not impossible that a complete table may be published in some form before long. In general terms, the practicability of making a given division can be ascertained by dividing the numerator of the fraction representing the greatest possible number of divisions with two given circles by the number proposed to be indexed. If the division leaves no remainder, the quotient gives the number of holes to be taken in each circle. This number may, however, be reduced as explained above. Taking as an illustration the case mentioned above; suppose it is desired to index the number 99. One hole each way in the circles 33 and 27 gives a division of 5,940, and 5,940 divided by 99 gives 60, which is the number of holes required in each circle, this being reduced to 15 holes in the 27 circle, and 5 holes in the 33 circle, as already explained.

This principle may also be applied to the construction of index centers, such as are used on plain milling machines, shapers, planers, etc. Fig. 1 gives a sketch of such a center where the worm is dispensed with, and the index-plate is on the spindle. In a center constructed in this way, the plate is not fastened to the spindle, but turns freely upon it. The index-pin p is arranged the same as on the B & S machine, *i. e.*, so that it can be adjusted to engage with any circle of holes in the plate, and, when withdrawn from the plate, can be turned, carrying the spindle with it. On the opposite side of the plate is a second pin p', which is so arranged in the slotted arm a that it can be adjusted vertically to also engage with any circle of holes in the plate. The arm a is cast solid to the head, and the index-pin p' does not move except in adjusting it. It will be seen that, with a center of this kind, provided with the proper circles, ordinary numbers can be indexed in the ordinary way by a simple movement, indexing by either pin, as happens to be most convenient, the mechanism for giving it the extra capacity not interfering in the least with its use for small numbers, nor altering the manner of using it. But when a large number, or one not provided for in the plate, is to be divided, the chances of being able to do it would be very good. As an example of the increased capacity gained in this way, take the case of a well known center, which is on the market, having circles of 48, 52, 54, 56, 60 holes. Of course the greatest number which can be divided by this plate in the ordinary way is 60. Arranged with two pins as shown, the greatest possible number would be that produced by moving one hole each in the 56 and 54 circle, which would produce a division of 1,512. Taking 4 holes in these two circles would give 378 and so on. Numerous examples of the kind could be given, but one more will suffice. Supposing our plate to have circles of 36 and 40 holes among the others. These two circles would be available for use in the common way, and when combined for differential dividing, one hole taken in each would produce $\frac{4}{1440}$, which is reducible to $\frac{1}{360}$, or one degree of arc. Thus with a plate having no more than 40 holes in it, degrees can easily be graduated. It is evident that the plate may take any form thought to be most convenient, as, for instance, in the form of a cylinder with one pin at the side and the other in the position of p, holes in this case being provided both on the sides of the cylinder and at the end.

The plate can be flattened out into a straight strip and the spindle replaced by a slide, and the principle is then applicable to straight line dividing. A sketch of such an arrangement is shown at Fig. 2 where P is a plate having rows of holes variously spaced. This strip is arranged to slide freely endwise, and is only prevented from doing so by the index-pin p', which is supported in a bracket a, which is attached to the frame of the machine. This frame is not shown in the sketch, because its form is not essential, and only those parts are shown which are essential to a clear explanation of the principle involved. The index-pin p is supported in a bracket, which is attached to a slide b, upon which the work to be spaced, graduated or drilled, is clamped. Now, if the index-pin p' be withdrawn, the plate P and the slide or platen b can move freely endwise, but both must move together. But if index-pin p only be withdrawn the platen b only can be moved; while if both pins are drawn out the plate P can be taken out entirely. Not wishing to impose too much upon the patience of the reader, I will not go much into details regarding this, but it is sufficient to say that the same principles apply as in the case of circles, and the computations may be made in the same manner. For instance, if there are in the plate two equal spaces divided into 12 and 10 holes respectively, a movement of one hole each way will give a resultant movement to the platen of $\frac{1}{10} - \frac{1}{12}$, which is $\frac{1}{60}$. Mr. Gribben's rule for factoring also comes in play here, as in fact it also does for the center Fig. 1. Any unit of length may be taken for division in this way, but for very fine divisions of the inch it would of course be necessary to have graduations in place of holes and microscopes for reading them, instead of index-pins.

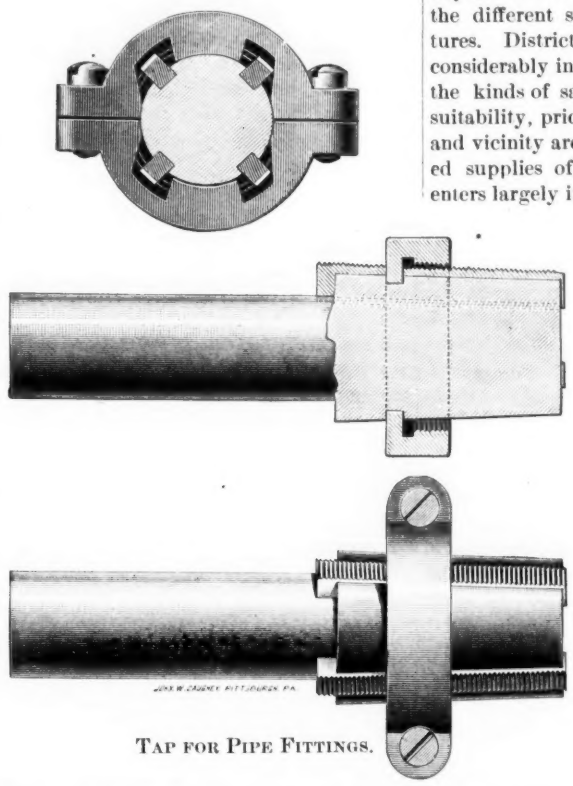
Tap for Pipe Fittings, Valves, etc.

The engravings show a form of tap for the above named purpose, made by Lewis D. Castle, Greensburg, Pa.

The inserted cutters are made rectangular in their cross-section, thus dispensing with the "dovetail" grooves and cutters usually employed, when inserted cutters are used in a body of inferior steel. This gives an opportunity for adjustment, by placing thin strips of metal or paper under the cutters. The clamping ring for holding the cutters in place, and bringing them into their proper alignment, so they "lead" correctly, is made of a steel casting, being threaded internally to correspond with the thread on the cutters with which it engages, and also having lugs which fit into a groove cut in the body, the purpose of these lugs being to prevent any end motion of the cutters. This ring is made in one piece, and after the thread is cut the lugs are faced off true with the thread. The holes are then drilled and tapped for the clamping screws, after which the ring is sawed into two pieces, and when clamped upon the cutters in the body, with the lugs in their recesses, it is impossible for the cutters to get out of line. These cutters have parallel sides; that is, they do not taper, and the same cutter is used in either a straight or tapered tap. By having the grooves milled in the body of a tapered tap, so they are parallel at the bottom with the tapered surface of the body, the cutters from a straight tap are used in a tapered one.

The sizes of the bodies of taps are varied, so that only two kinds of cutters are required to tap all sizes from 1¼ inches to 12 inches inclusive, either tapered or straight. The cutters having 11½ threads to the inch are made 3½ inches long, and those with 8 threads are 4 inches long. Then, as they become worn on the ends, they are set forward in the body and the projecting ends ground off. If one cutter should become broken, and the remaining cutters be good, it is not necessary to throw all away, as the cutters are interchangeable, and a cutter may be placed in any groove, and when clamped by the divided ring it is brought into the proper lead with the others and is kept there by the ring. When a shop is provided with a set of these taps, the cutters can be ordered in quantities and kept in stock, at a very much less cost than a manufacturer without special tools could produce them.

It is claimed for these taps that there is a very material saving of time in their use, as, when worn slightly, the cutters can be set out,



TAP FOR PIPE FITTINGS.

thereby avoiding the waste of time in running in further to maintain the size. They are made for either machine or hand work.

Core Making.

BY S. BOLLAND.

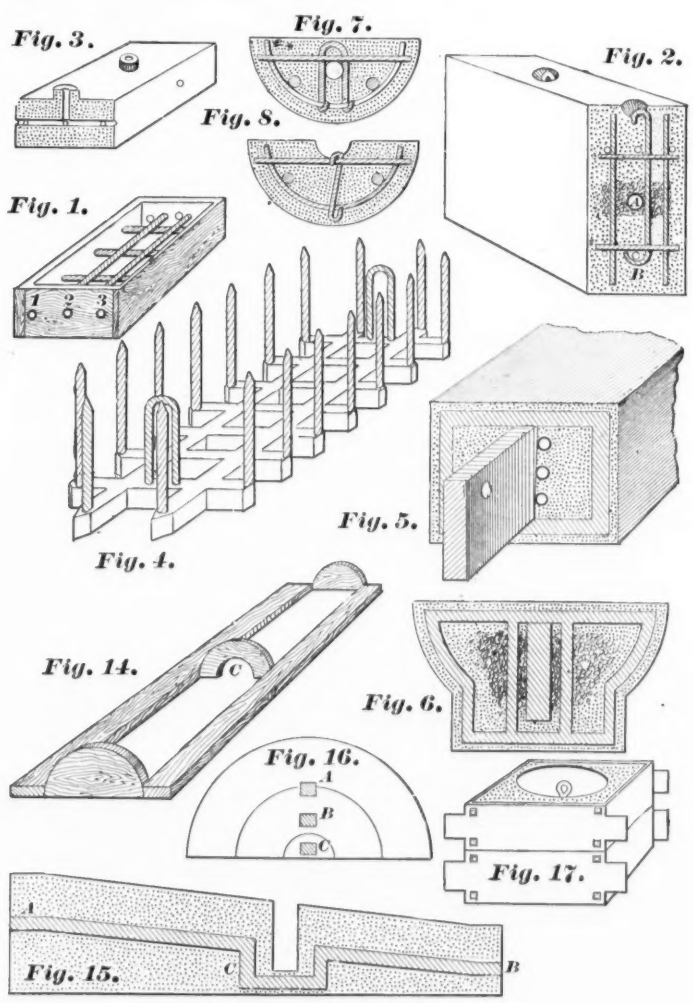
FIRST PAPER.

The initiatory branch of the moulders' art is core making; and why such an important subject should be left so much in the background I am at a loss to understand. I consider it to be the foundation of the business, and feel assured that sufficient stress is not laid upon the importance of our apprentices learning that part of their trade thoroughly.

It is not uncommon to see good moulders placed at a great disadvantage from their inability to make their own cores. This should not be the case. Every moulder ought to be able to do this.

Let us first consider the material needed for core making. To insure success in this department requires skill in the selection of the different sands, and their several mixtures. Districts widely separated will vary considerably in this particular; according to the kinds of sand nearest to hand, and their suitability, price, etc. The city of New York and vicinity are fortunate in having unlimited supplies of beach or white sand, which enters largely into the mixtures for general work. Especially is it well adapted for small jobbing cores, being very fine and easily worked, and, after being burned in the casting, giving little trouble to clean. But in the country, where white sand is out of the question on account of the cost for carriage, the river sands are used instead, with slight variations in the mixtures.

The next in importance is the coarse, sharp, or, as it is by some called, fire sand, on account of the resistance it offers to the high temperature of the molten iron. This sand is valuable also, because, being so open in its grain, it permits the gases formed during the process of casting to escape freely, or, as is most commonly said and understood by moulders, "the air comes off good." But, good as these sands are, they would be valueless alone, because, containing little or no clay, as most other sands do, they will not hold together by the regular method of dampening and ramming. Consequently, in order to utilize them we resort to artificial means to bring them up to the proper consistency. The most common things used for this purpose are flour, molasses, clay, resin and glue. There are many other things used, but for all practical purposes I consider the ones mentioned will meet all requirements.



CORE MAKING.

Moulding sand is also used in the core mixtures to help them up to the required stiffness, on account of its possessing in a great measure the elements lacking in the white and fire sands. But, on account of its finer nature neutralizing the good derived from the openness of the fire sands, it must be used only for the purpose of stiffening, as before mentioned. Moulding sand, so called, is that which is used for the legitimate purpose of moulding—as the filling of foundry floors, sand heaps, and—when suitably treated by the admixture of the necessary ingredients—for the facing of patterns. As previously stated, the kinds of moulding sand differ according to the districts from which they are got, yet, as they are all chosen with the view of best suiting the work for which they are required, I think it will not be difficult to determine which is needed after the enumeration of some of the most useful kinds, and the particular virtues they possess.

The Albany and Waterford sands are chiefly valuable on account of their fineness, being graded from No. 1 up to the coarsest kinds. The No. 1 is used for the finest kind of work, such as stove, register, very light machinery, etc. But for the heavier kinds of jobbing and machinery work, the Jersey sands rank A. No. 1, being of a tougher nature on account of the larger percentage of clay which enters into their composition. There are also three grades of this sand, the medium being the most useful. But, as this sand contains so much more clay, we need great care in its use. Its property of adhesiveness makes it valuable for the heaps and floor. But for the facing of patterns we have recourse to the mixtures before spoken of, these mixtures being required as well for the easier and safe working as for the purpose of conducting the gases from the surface of the mould. I shall say more on these subjects in their proper place, and shall now proceed with the subject of core making, first giving a list of mixtures which I have proved to be the best for the work for which they are intended.

CORE SAND MIXTURE NO. 1.

10 parts white sand, 1 part flour, with water sufficient to make it work easily.

No. 1 mixture is for small jobbing, round and square, and all cores not too large, and where the iron in pouring does not strike the core. A little water sprinkled carefully over the cores, before putting into the oven, will give a harder skin.

CORE SAND MIXTURE NO. 2.

7 parts white sand, 3 parts fine Jersey moulding sand, 1 part flour, with water sufficient.

No. 2 mixture is for cores requiring a little tougher sand, and will cling together better than No. 1, enabling you to bring up the edges good, and is suitable for small port cores for cylinders, pumps, etc. Sometimes I have found it necessary to change these mixtures to suit intricate jobs having very thin cores in them, and difficult to vent. In such cases I have (after failure with mixtures No. 1 and 2) had recourse to the following, never knowing them to fail in cases where the proper precautions were taken to make and secure the vents.

CORE SAND MIXTURE NO. 3.

10 parts white sand, 5 parts moulding sand, 2 parts No. 1 mixture, 2 parts resin (ground very fine). Mix with water and sprinkle a little weak molasses water on cores.

CORE SAND MIXTURE NO. 4.

Mix thoroughly, when dry, half and half river sand and fire sand, sift through a fine sieve; then to 15 parts of mixed sands add 1 part of resin, ½ part of flour, and mix with weak molasses water.

CORE SAND MIXTURE NO. 5.

8 parts fire sand, 2 parts Jersey moulding sand, 1 part flour. Mix with thick clay water.

No. 4 is a good substitute for the "white" sand mixtures. No. 5 is an excellent mixture for larger cores, and is the best dry sand facing for any ordinary work, such as cylinders, pumps, etc., up to 40″ diameter, requiring very little venting if thoroughly dried. It is also suitable for large pipe and other cores, for which the other mixtures are not suited on account of the tendency of the

white or river sand to melt or scab. Pipe cores made of No. 5 mixture will enable the moulder to gate or run his casting on the top, an absolute necessity sometimes where a sound casting is required.

I need not give any more mixtures for core sands, as a slight modification of the above will enable the core maker to meet all demands on his ingenuity.

LOAM MIXTURES FOR CORES ON BARRELS.

Where the loam must be made by hand, the mixture is 5 parts fire sand, 2 parts Jersey moulding sand, 1½ parts manure. Thick clay wash to suit.

If ground in the mill the ingredients will be 7 parts fire sand, 2 parts moulding sand, 2 parts manure. Thick clay wash.

The reason for the increase of fire sand and manure, is that the mill grinds the ingredients into a finer mass than they can be mixed by hand, therefore, to preserve the openness required, more fire sand and manure are added, but care must always be taken not to grind the mass longer than is necessary to mix it well.

RIGGING FOR CORES.

Another important item in core making is the rigging for securing, venting, transportation, etc., and to be able to make the best use of such tackle as may be on hand, as well as to get up new arrangements if actually needed. I have frequently seen immense waste of time and money caused by the elaborate nonsense of some would-be genius, who, if he had looked carefully into the job, would have been able to do it twice over with the rig he had around him, and in much less time than it took him to use the complications he had pondered out.

To begin with, we will take a very simple example, that of a flat core 2 feet long, 1 foot wide, and 6 inches thick. Suppose it stands out of the mould at each end 3 inches; except at the ends, metal is supposed to cover the whole of the core. Now, all we have to do in this case is to secure the sand with rods, both ways, and take the vent out through the ends, as at Fig. 1 (page 5). Such a core as this would require No. 5 mixture. Now this is a very ordinary core to make, but, retaining the same width and length, and changing the depth, we shall meet new necessities. Let us suppose our core to be 24 inches deep, and we find that we must tie our core in its depth as well as in its width and length; better provision must also be made for carrying off the gas than is shown at Fig. 1, as the three holes, 1, 2, 3, will not be sufficient for that purpose. Allowing that we have nothing but rods to make our core with, we must put in two sets of irons, 6″ from each end of the core, in the same manner as shown at Fig. 1, and also ram up other irons on end, to tie the core in its depth.

To lead off the gas we either increase the number of holes, or, what is better, we can, in this case, have a hole in the center, 1½ inches diameter, through which a bar can be put, and, after ramming up to the vent rod and venting down to the bottom of the core, cinders must be placed to the depth of 3 or 4 inches, taking care that they do not come to the outside. After ramming the remainder, vent down to the cinders. It will be readily seen that, by this method, every part of the core is reached by the vent wire, and, consequently, the gas will freely escape through the one large hole in the middle, as *A*, Fig. 2.

Another advantage in limiting the number of vent-holes is that the moulder can secure his work more readily and securely. Now, as this core cannot be as easily handled as the smaller one, some provision must be made for lifting it into the mould, and, as we have supposed that our core comes through at the ends of the mould, a hole may be made, through which a bar can be passed, or hooks may be rammed up in the core, taking hold of the bottom irons or rods.

Fig. 2 shows section of core where the hook *B* comes, and explains at a glance the different instructions given.

Let us now suppose that our core is 1″ thick, and we at once see that our room for rods and vents is very limited. We must, in this instance, be careful to have the vents evenly divided a little below the half.

The vent rods and long irons being placed after ½ inch of sand is rammed in, the short rods, to tie the whole together, can be laid across, and the ramming completed. Care must be taken in drawing the vents, or the core will be split. We have, in this case, something to contend with which does not occur in the other cores. The rods cannot exceed ¼ inch diameter, and, being so much weaker, will require more careful handling. We must remember also that, being so much shallower than the others, the iron, in pouring, will cover the core quicker, and the vents, being so much smaller, cannot convey the gases away as fast as they should do, especially so when the core is very hard. To overcome this difficulty it is best to make all this class of cores in fire sand alone, mixed with molasses water of medium strength. This leaves the sand very porous, and there will be no difficulty.

But, should it occur that the cores we have been speaking of had the iron cast on all six sides, we must then adopt another method to carry off the gas. In the case of a core 6 inches deep we pass other vents connecting with those running through the length of core, and connect these with the place where we are to take off the vent (which is usually on the top) by as large a hole as possible. Fig. 3 shows the position of vents, which, when all is clear and free, are stopped securely on the outside. In the case of the core with cinders we simply place upright vents leading from the cinders to wherever the gas is to be taken away.

It may be here stated that, where you have only very small holes through which the core must be taken when cleaned out, there must be as few irons used as possible, and no wrought-iron where cast will do.

In some jobs where the core is not too large, sticks of wood may be used to stiffen the core, and, where this can be done with safety, a great amount of trouble is saved in the cleaning.

[Reference will be made to some of the engravings on page 5 in another paper on this subject.]

LETTERS FROM PRACTICAL MEN.

Differential Movements in Indexing.

Editor American Machinist:

Complying with your request, I send the following explanation of the method of computing my table of divisions published in your issue of October 31.

In order that there may be no misunderstanding, I will say that by outside row I mean the row of holes that engages at the back with the pin on the framework of index head that ordinarily prevents the plate from rotating. By inside row I mean any other row on the same plate. By forward movement of the worm shaft, I mean such movement as will carry the work in the desired direction. By backward movement I mean moving the worm shaft so as to cause the work to move in a direction the reverse of that desired.

Let a = number of holes in outside row;

Let b = number of holes in inside row;

then a forward move of one hole on inside row, and a backward move of one hole on outside row, would turn the worm shaft forward by an amount equal to $\frac{1}{b} - \frac{1}{a}$; which expression simplified becomes $\frac{a-b}{a\,b}$. Also, the main spindle of index head will be advanced $\frac{1}{40}$ of this amount, or $\frac{a-b}{40\,a\,b}$ of a turn. The number of teeth or division this move will give will be the reciprocal of this last expression, or $\frac{40\,a\,b}{a-b}$. That is to say, a forward move of one hole on an inside row, and a backward move of one hole on an outside row, will give a division of the circle equal to forty times the product of the two rows under consideration, divided by the difference of these two rows. This is what I call, for sake of convenience, the one-hole basis of operations, by which most of the divisions in the table are obtained; but further on I will explain a variation of the process, by which a few more divisions may be made.

The expression, $\frac{40\,a\,b}{a-b}$ represents the *greatest number of teeth* that can be cut with the rows a and b by moving one hole on each row. It will be at once evident that one-half this number can be cut by moving over two holes on each row, one-third this number by moving over three holes on each row, etc.

In order to facilitate operations I worked by prime factors. I took each pair of available rows of holes and grouped them and their prime factors along with 40 and its prime factors (corresponding with $40\,a\,b$ in the algebraic expression), and then struck out of each group the factors whose product was equal to the difference of the two rows in that group (corresponding with $a - b$ in the denominator) as per accompanying table.

TABLE OF GROUPS OF FACTORS.

40=2×2×2×5 20=2×2×5 19=19 — 1	40=2×2×2×5 33=3×11 31=31 — 2	40=2×2×2×5 49=7×7 47=47 — 2
40=2×2×2×5 20=2×2×5 18=2×3×3 — 2	40=2×2×2×5 33=3×11 29=29 — 4	40=2×2×2×5 49=7×7 43=43 — 6 not available.
40=2×2×2×5 20=2×2×5 17=17 — 3 not available.	40=2×2×2×5 33=3×11 27=3×3×3 — 6	40=2×2×2×5 49=7×7 41=41 — 8
40=2×2×2×5 20=2×2×5 16=2×2×2×2 — 4	40=2×2×2×5 33=3×11 23=23 — 10	40=2×2×2×5 49=7×7 39=3×13 — 10
40=2×2×2×5 20=2×2×5 15=3×5 — 5	40=2×2×2×5 33=3×11 21=3×7 — 12	40=2×2×2×5 49=7×7 37=37 — 12 not available.

Arranged on a one-hole basis.

You will notice there are three groups (20 and 17, 49 and 43, 49 and 37) in which there is no factor or factors equal to the difference of the two rows. Therefore, these groups are not available for the one-hole basis of operations.

Now, in order to find if a certain division can be obtained by this differential method, resolve the number in question into its prime factors, and see if all these factors can be found in any one group. If they can, take them away from the group, and those that remain, multiplied together, will give the number of holes to be moved over on each row. For example:

$69 = 3 \times 23$; these factors are found in the group of 33 and 23 rows; the remaining factors 2, 2 and 11, being multiplied together, give 44, the number of holes to move over on each row, or $\frac{44}{23} = 1\frac{21}{23}$ $\frac{44}{33} = 1\frac{11}{33}$.

Omitting the whole turn on each row we have $\frac{21}{23} - \frac{11}{33} = \frac{40}{69}$, which is what is required.

Another example:

$96 = 2 \times 2 \times 2 \times 2 \times 2 \times 3$; these factors are found in the group of 20 and 18 rows, the remaining factors being 3, 5 and 5, which multiplied together give 75, the number of holes to move over on each row, or $\frac{75}{18} = 4\frac{3}{18}$ and $\frac{75}{20} = 3\frac{15}{20}$. Omitting three whole turns on each row we have $1\frac{3}{18} - \frac{15}{20} = \frac{40}{96}$, which is what is required for a division of 96.

After constructing the table of groups of factors, I factored all the numbers that the B and S table omits, and inspected the group table to find if they were contained therein, and this is all the "cut and try" work there is about it. After we know that the factors of any number are contained in our group table, it is a very simple arithmetical operation to determine the number of holes to be moved over to obtain that particular division.

It is quite evident that the fewer factors that are struck out to compensate for the difference of the two rows, the more we have left among which to find the factors we are seeking. That is to say, the smaller we can make the denominator of the expression $\frac{40\,a\,b}{a-b}$ the more likely is that group to be available. Or, if we can reduce this denominator to 1, we don't lose any factors from that group. For instance, the group 49 and 43, which is not available on the one-hole basis, (as previously explained), can be used if we move over 8 holes on the 49 row and 7 on the 43 row as a basis, or $\frac{8}{a} - \frac{7}{b} = \frac{8\,b - 7\,a}{a\,b}$.

Dividing by 40 and taking the reciprocal we get $\frac{40\,a\,b}{8\,b - 7\,a}$. Substituting the values 49 and 43 for a and b respectively, our denominator becomes 344 — 343 = 1. Hence, none of the factors in the group 49 and 43 will have to be struck off. But after the factors of the given number have been taken out, those that remain must be multiplied by 8 for the number of holes to be moved over on the 49 row, and by 7 for the number to be moved over on the 43 row.

For example: $301 = 7 \times 43$; these factors are found in the group of 49 and 43 rows, the remaining factors being 2, 2, 2, 5 and 7, which multiplied together give 280. But as our expression in this instance was founded on a basis of 8 holes on the 49 row and 7 on the 43 row, 280 has to be multiplied by 8 for the 49 row, and by 7 for the 43 row, or $280 \times 8 = \frac{2,240}{49} = 45\frac{35}{49}$ and $280 \times 7 = \frac{1,960}{43} = 45\frac{25}{43}$. Omitting the 45 whole turns on each row we have $\frac{35}{49} - \frac{25}{43} = \frac{40}{301}$, which is what is required for a division of 301.

By applying the foregoing principle to some of the groups we may gain a slight advantage in some cases, by striking out fewer or different factors. For instance, if in group 20 and 17 we move over 5 holes on the 20 row and 4 on the 17 row as a basis, we only lose 5 as a factor. Or, if we move over 6 holes on the 20 row and 5 on the 17 row as a basis, we only lose 2 as a factor from that group. Again, in the 33 and 23 group, if we move over 3 holes on the 33 row and 2 on the 23 row as a basis, we only lose 3 as a factor. Also, if we move over 4 holes on the 49 row and 3 on the 37 row as a basis, we can use that group without the loss of any factors. And in the 33 and 21 group if we move over 3 holes on the 33 row and 2 on the 21 row, we need only strike off 3 from among the factors of that group. Finally, if we move over 8 holes on the 33 row and 7 on the 29 row as a basis, we may use that group without the loss of any factors. Another point in using some other than the one-hole basis is, that the backward move may or may not have to be given on the outside row.

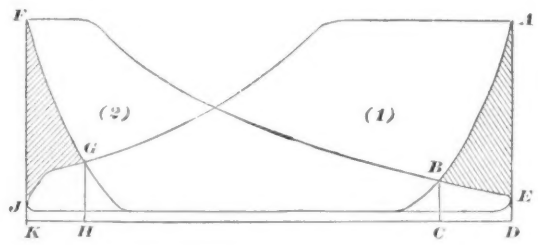
WALTER GRIBBEN.

Variable or Fixed Compression for Variable Cut-off.

Editor American Machinist:

In your issue of Nov. 14, 1889, you raise an interesting point relative to the correct adjustment of engine valves for smooth and cool running at high speeds, and seem to indicate that compression should be increased as the cut-off is shortened. In the consideration of this question, the investigator will find two lines of practice followed by experienced constructors, diametrically opposed, and each vigorously supported; engines with single valves, controlled by link motion or shifting eccentrics, and engines with inde-

pendent steam and exhaust valves, giving a constant compression and variable cut-off. The "first" type of engines necessarily increases the compression as the cut-off is shortened, and from this fact the conclusion is frequently drawn that since the action exists it must be right. But, on the other hand, can it be fairly claimed that engines with fixed compression do not run at least as well as those in which the compression varies? If this be denied, it must be acknowledged that the builders of the Corliss, the Straight Line and other types of engines with fixed compression and variable cut-off have been on the wrong track. The object of compression as generally understood (that is, in relation to



cool and smooth working,) is to act so gradually, in taking up lost motion and arresting the movement of the reciprocating parts near the extremities of the stroke, that pounding and jars shall be prevented. Now if the speed of an engine is practically constant, it will probably be admitted that the *effective compression* (or mean height of compression area measured from the point where the compression or back pressure equals the forward pressure on the piston) required is a definite quantity, having the same value for all points of cut-off. The accompanying figure represents two indicator diagrams with the same ratio of compression in each, but with different ratios of expansion. For diagram (1), the back pressure equals the forward pressure at the point *G*, and the effective compression (or preponderance of back over forward pressure) is the mean height of the area *F G J*, exerted through a distance *H K*. If this compression is sufficient for smooth and cool working, then the effective pressure of diagram (2), at a shorter cut-off (being the mean height of the area *A B E*, greater than the mean height of the area *F G J*, and acting through a distance *C D*, greater than the distance *H K*), will be excessive; and the ratio of compression should apparently be diminished, at the shorter cut-off, instead of being increased. The effect either of too much or too little compression may be to produce pounding, with the additional disadvantage in the former case, that the effective pressure on the piston is diminished. This point has been clearly recognized by some of our best designers, notably by Mr. John E. Sweet, who sets the valves of the Straight Line engine with constant compression and variable lead, diminishing the lead as the cut-off is shortened, and making it negative at very short cut-offs—for the purpose of maintaining a practically constant effective compression at all points of cut off. An interesting description of this adjustment was published in the AMERICAN MACHINIST of May 2, 1889; and it is just possible that the smooth running of high-speed engines, where the compression increases as the cut-off is shortened, is caused in spite of this adjustment, rather than on account of it. RICHARD H. BUEL.

[If Mr. Buel will again read the article in our issue of Nov. 14, to which he refers, we are sure he will find that we did not "indicate that compression should be increased as cut-off is shortened," in the instance of an engine running at constant speed; we simply noted the fact that in high-speed stationary (not low-speed, like the Corliss type,) high compression had generally been found a necessity for smooth and cool running. There is no one likely to dispute the statement that in such an engine less compression will be required to bring the reciprocating parts at rest in the case of an early than in that of a late cut-off. This was explained in connection with the description of the engine to which Mr. Buel refers near the conclusion of his communication. But a locomotive does not run at a constant speed, and it is fortunate, for this and for other reasons, that compression is highest at highest speed, and, incidentally, at early cut-off.]

Wants to Know Why the Gauge Glass Broke.

Editor American Machinist:

By mail I have sent you a gauge glass with side blown out, for your examination. I have always heard of what I regarded as a superstition—that if a glass be taken out and swabbed clean inside, it would surely break. In the afternoon I had glass swabbed out with coal oil in the course of general cleaning up, and that night it broke with less than fifty pounds pressure, although it had been run in the evening at 60 to 70. Will you ask in your columns for opinions on this subject, as I believe it is worthy of investigation. HERMAN DOCK.

We have at different times referred to the advisability of building subways under the principal streets in New York for electric wires, pipes, etc., these subways being large enough to admit workmen. Now the grand jury begins to see the advisability of something of the kind, and their recommendations are practically the same as ours, first referred to five or six years ago. They say:

It is the opinion of the grand jury that, whenever possible, subways should be constructed which would include ample space in the tunnel for the gas, steam and water pipes and wires, traction cables and similar uses, instead of, as at present, allowing each separate interest the exclusive use of a separate part of the street.

The grand jury also, at this late day, condemn, just as we did at the time the appointments were made, the institution of a board of electrical control, the individual members of which know nothing about the matters they were to control.

The grand jury say:

The grand jury present to the court that, in their opinion, it was a grave error to entrust such important interests to a commission or board having no practical acquaintance with the subject of electricity, either theoretical or applied. They believe, from evidence presented to them, that the present board of electrical control have been negligent as well as incompetent, and are largely responsible for the slow and unsatisfactory manner in which the wires are being removed from our streets, and are worthy of censure in this respect, and that, as soon as possible, without the serious impairment of vested interests, this board should be removed, and the control of electric subways and service should be entrusted to competent supervision.

The present grand jury are, of course, in no way responsible for what has been done.

Methods of Reducing the Fire Loss.

BY C. J. H. WOODBURY.

Abstract of a Paper read at the New York Meeting of Mechanical Engineers.

In this paper the author points out the fact that the fire loss is a most oppressive tax, much of which might be prevented by the exercise of proper precautions. A table of mill fires for more than a generation showed that the largest fires had not reached their destructive results through the absence of what could be considered adequate apparatus, but by the lack of care or suitable management of such apparatus. He said:

In a manufactory there is a wide distinction to be made between to-day's dirt and yesterday's dirt, meaning by the first the rubbish necessarily incident to manufacturing, and by the second its neglect. Nearly every kind of by-product is liable to spontaneous ignition, and should be removed to a place of safety before night. This precaution does not apply merely to oily waste, but to every kind of waste material, even including iron turnings, whose oxidation, when wet, is a frequent cause of fire. It is not safe to make a discrimination in regard to oily waste, because there are numerous fires starting in what is considered, and truly appears to be, clean waste. The best waste-boxes are made of galvanized iron, like small ash-cans, except that they are provided with short legs, so as to stand about four inches above the floor. The waste-cans, after being emptied at night, can be overturned in the middle of the floor; any infraction of this rule to be reported by the watchman. . .

The watchman should be a strong, efficient man, and not, as is frequently the case, employed for the position because he is good for nothing else, and can therefore be hired cheaply. He should understand how to start the fire pumps, as well as to manage any part of the fire apparatus. As property should be watched during the day, Sunday as well as at night, it is under the care of the watchmen about five-eighths of the time, and material that was highly combustible when heated. Oil should be stored in an outside building, either below the ground or banked around, and great care should be exercised in drawing it.

Regarding fire organizations, he said:

The details of such organizations differ with the arrangements and administration of every mill; but the general policy of definitely assigning persons to the positions for which they are best adapted, and where it is presumed they could be most useful, and to practice them in such work, is a rule which is common to all. In establishments like steel works, where the operation is continuous, it is necessary to have an organization made up from each of the gangs of men. By way of a distinctive feature, the members of one fire organization are provided with belts with a special clasp, and when any person wearing one of these belts leaves work, he is to give up his belt to his alternate before leaving the yard. In this manner, by retaining the wearers of the belts always on the premises, it is arranged that there shall always be a fully manned fire organization present during the working hours of the week. . . .

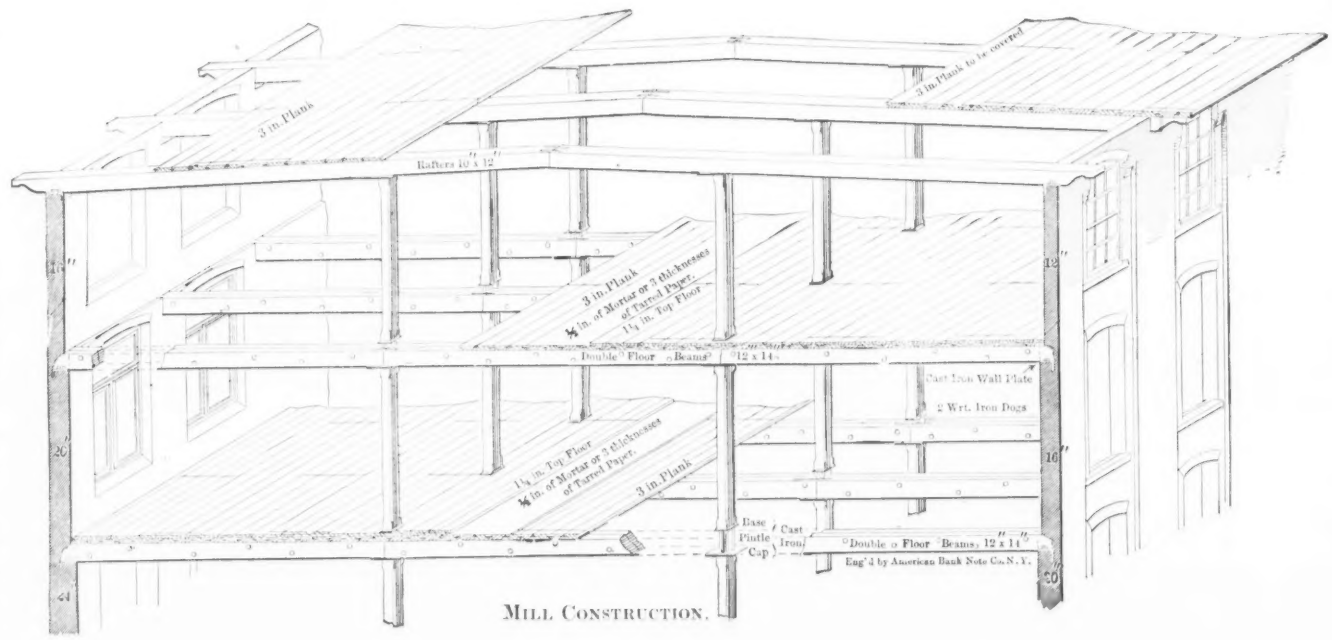
The practical results of such fire organizations, where fire has occurred, have been very marked, and systematic and skillful work has been the rule in place of the needless confusion and liability to breakage of fire apparatus, which almost inevitably occurs where there is a lack of such organization.

In his reference to mill construction he alluded favorably to the method known as slow-burning construction — no concealed places, and as few projecting timbers as possible.

Mill floors should be laid on beams of southern pine, 8 to 10 feet centers, and it was preferable that they should be made of pieces bolted together with distance pieces, to leave an inch air space.

The engraving will serve to explain his recommendations as to mill building.

Floors near the earth in basements should be well ventilated, if there is a space between the floor and the surface of the earth, but unless that space is continuous, and two or three feet in height, it is better to lay the floor directly upon the earth, taking care to prevent dampness by putting in a layer of stones or cinders. Above this the sills for the floor are laid in a trench with coal tar concrete, which is also laid between the sills on a level with the top of them, and the floor boards are laid over this. When well-seasoned chestnut is used for this purpose, it will last a great many years without dry rot. Cement concrete will cause timber to decay rapidly.


3 in. Plank
3 in. Plank to be covered
Rafters 10 x 12"
3 in. Plank
¾ in. of Mortar or 3 thicknesses of Tarred Paper.
1½ in. Top Floor
Double Floor Beams 12 x 14"
Cast Iron Wall Plate
2 Wrt. Iron Dogs
1½ in. Top Floor
¾ in. of Mortar or 3 thicknesses of Tarred Paper.
3 in. Plank
Base
Pintle
Cap
Cast Iron
Double Floor Beams, 12" x 14"
Eng'd by American Bank Note Co. N. Y.

MILL CONSTRUCTION.

Fires from spontaneous ignition of bituminous coal were hard to conquer, and such coal should not be stored under valuable buildings, nor in contact with timber. If the depth of coal exceeded 8 feet, iron rods should be pushed to the bottom every day and examined for heating.

Automatic sprinklers had proved to be a most valuable form of fire apparatus, but their introduction should not displace other forms of apparatus.

Fire pumps were generally too small, five hundred gallons per minute being the minimum capacity recommended.

The National Railway Publication Co., 46 Bond street, New York, have issued an excellent map of the railroads of the United States, Canada and Mexico. This map is free to every subscriber to the *Official Railway Guide*, published by this company.

The latest—at this writing—full fledged trust is that in the interest of the wire nail and barb wire manufacturers. The Federa Steel Company is the name of the new combination.

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NEW YORK, DECEMBER 12, 1889.

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Fire Losses.

It seems not unlikely that the many disastrous fires which have occurred this year will result in an increase of insurance rates, as of course all very large fires have a tendency to do. When a considerable time passes without many or especially disastrous fires, a feeling of security takes possession of the people, which is shared apparently by the insurance companies. This, together with the competition for business of new—and in many cases comparatively weak—companies, results in risks being taken at rates which a few large fires coming together prove to be too low. Some of the weaker companies suspend, and the remaining ones raise, or at least stiffen their rates.

Insurance rates are a tax upon business, and manufacturing industry, which, along with all other items of expense involved in the production and distribution of goods, is added to the price of those goods, and must be finally paid by the consumer. And as all people are consumers, it is evident that the loss must eventually fall upon all, and upon each in proportion to what he consumes. And as a much larger proportion of the income of the poorer people is spent for things which they must consume in order to live, than is the case with those who are wealthy, it follows that the poorer people really bear the heavier part of the burden imposed by such disasters, and that it is not true—as many working people are led to believe—that a large fire or other disaster which destroys large amounts of property can be a benefit to working people by stimulating wages. It would be the same if the insurance system were not in use, for all such losses would have to be provided against, as a condition to the doing of a safe business.

No amount of sophism can permanently hide the fact that the consumer must eventually pay all necessary expenses involved in the production of the goods he consumes. Insurance rates are part of this expense, and are uniformly shifted to the consumer. It is, therefore, not true that the loss from large fires—such as occurred at Lynn and Boston—fall chiefly upon property owners as a class. In reality it falls lightest upon them.

It has been argued that the insurance system tends to carelessness in building, and in providing against fires, and that it is an open question whether it would not be better for the community upon the whole if there were no such thing as insurance against loss by fire, and each individual had to bear the full consequences of his carelessness. While there may be something in this argument, so far as it relates to ordinary insurance, it certainly does not apply to such insurance as is conducted by the Associated Factory Mutual Insurance Companies of New England, which exercise a constant supervision over buildings insured, and in which the effects of a fire are felt by each member at the end of the year in decreased dividends. It is to the direct interest of every one interested in such companies to keep the fire risk, and consequently the rates, as low as possible, which cannot be said of ordinary stock companies, which may make more money with high risks and premiums than with low ones. The manufacturers, by the formation of such an association, have set an example to other interests which they will do well to follow.

The fire in Boston has again proven what has been proven before, *i. e.*, that the so-called fire-proof constructions are not really fire-proof at all, and that under certain conditions such buildings seem to burn readily, and collapse quickly. No doubt it was the discovery of this fact that led the companies spoken of above to abandon the use of the term "fire-proof" entirely as applied to buildings, and to confining their efforts to the designing of what they term "slow burning constructions." Only the day before the Boston fire, one of the Boston papers said that it was practically impossible for such a fire to take place in that part of Boston, which actually did burn up the next day, giving a very good illustration of the misplaced confidence which is put in fire-proof buildings. All this is not particularly reassuring for New York, with her short supply of water, that cannot probably be increased for a number of years yet. There can be very little doubt that this city is yet to see a conflagration which will be memorable. If she escapes, it will be by mere good luck more than anything else.

Freaks of Memory.

A good many people depend too much upon their memory. Memory is something likely to deceive those best equipped with it, and it is pretty sure to break down, if overworked.

Sometimes an impression made by seeing something, will years later come up in such a way as to convey the idea that it is just then thought out. An instance of this kind once came to the writer's notice. It was the case of an engineer who thought he had made an invention worth the cost of a patent. He made drawings of his supposed invention, laid it aside, and a few days later, in turning over the files of an English engineering journal, came upon one he had probably not seen for ten years. In this paper was an engraving of the identical device he supposed he had invented. The drawing he had made was a very fair copy of the engraving, differing only in some unimportant details. He consoled himself with the idea that it was of no practical value, otherwise he would have heard more from it.

Another, and a more humorous incident Dr. Coleman Sellers recently related to us. At a time when he was more intimately connected with the operation of the works at Philadelphia than at present, the company was building a large planing machine for the Russian government, and there was required, for a certain purpose, a special attachment. Mr. Sellers sketched the attachment, and a draftsman went to work at it. During the night Mr. Sellers awoke with the idea that the device had been patented, and there would be an interference declared. He lay awake, as many an engineer has done before, devising some other way to accomplish the desired end. In the morning he went to the works, and told the draftsman who was working at the device, that he thought it was already patented. With an amused smile the draftsman went to a drawer and took out patent papers about seven years old, securing the identical thing to Coleman Sellers.

There are things that must be remembered, or a system of notes too elaborate for ordinary mortals must be resorted to. The way to remember these is not to tax the memory with too much that can be covered by simple notes.

For some time past we have been publishing, alternately, articles on locomotive construction and on mechanical drawing, prepared by J. G. A. Meyer. These articles have been extended as far as seems practicable in newspaper form, and will be brought to a close in one or two more issues. We have had a large number of letters commending these articles, and there has been a constant demand for back numbers of the papers containing them. We have also reason to know that a good many readers have followed the articles on drawing, and laid the foundation of a knowledge of mechanical drawing, and that the articles on locomotive construction have been closely studied by mechanics. The manner in which these articles have been received has determined Mr. Meyer to supplement what he has written, as far as is necessary, and to publish them in book form. This he will do at as early a date as is consistent with his other duties.

At a recent public meeting of the carpenters of Jersey City, several speakers spoke against the advantages of holding a world's fair in New York. And their arguments, if good, would apply to any city in which the fair might be held. The arguments of these speakers, which were undoubtedly honest as the matter appeared to them, was that the work incident to preparation for the fair would bring a great many workmen to New York, and that, when the work of preparation was completed, there would be more men in New York and vicinity than there would be work for. There is, perhaps, a semblance of truth in this, but it will hardly stand investigation. Wherever the fair is held there will undoubtedly be an in-rush of workmen, but that in-rush will not be so great that wages will not be higher, and for two or three years workmen will get better pay. Then, in whatever city the fair is held, permanent business will be increased, and if there is a surplus of workmen in any branch, the men will scatter to other parts of the country, as is always the case, and in the end the workmen permanently located in New York and vicinity will find as much work as they do at present, with the advantage of having saved something while wages were high. The argument of these Jersey City carpenters is undoubtedly honest, but we think it is not well considered.

The daily papers a few days ago contained an account of a man who, after vainly trying to obtain work for ten months, became despondent and took carbolic acid to end his troubles. He was an educated man, speaking several languages, yet could find nothing to do. As time goes on it becomes less and less possible for men to get a living by virtue of having what is called an education. There are not too many educated men, but there are too many so unfortunate as to expect to get a living by virtue of having an education. A college education is an excellent thing to have, but between that and knowing how to do something that other people want done there is no comparison.

QUESTIONS AND ANSWERS

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(448) C. N., New York, asks: How much lead would you give the slide valve in an engine 15″x30″, number of revolutions 96? *A.*—If the lengths of the ports are nearly equal to the diameter of the cylinder, we should give about $\frac{1}{32}$ of an inch lead; if the lengths of ports are much less than the diameter of the cylinder, we should give it a little more lead.

(449) P. T. W., Warren, Pa., writes: Will you please explain the meaning and origin of the term "running with—or against—the sun," as applied to motion of machinery. *A.*—By the term "running with the sun," as applied to machinery, is meant motion in the direction of the hands of a watch, and "running against the sun" means motion in an opposite direction. These terms were used among millwrights years ago.

(450) J. F., New York, writes: I would like to have a steam launch built, about 20 feet long. I do not know whether to apply for a special license before I have the boat finished or whether I can get one without having the boat. *A.*—You may obtain an engineer's license at any time, the only requirement being that the applicant shall possess the necessary qualifications and experience for the position asked for.

(451) M. T., Bayonne City, N. J., writes: I have a tank built in the form of a half circle, 3 feet radius, and 9 feet 8½ inches long. I want to find the contents of each inch. Is there any simple way of doing it? *A.*—The diameter will be 6 feet, and the area of a circle 6 feet diameter is 4,071.5 square inches; consequently the cross-sectional area of the tank will be 4,071.5 ÷ 2 = 2,035.75 square inches; hence each inch of the length of the tank will contain 2,035.75 cubic inches. We have assumed that you have given us inside measurements. We have not made any allowance for braces.

(452) A. W. H., Portville, N. Y., writes: I wish to build a small steam launch to carry six persons at a rate of about 6 to 8 miles an hour, and draw about 13 inches of water. What should be the length, breadth and depth of the boat? Will a 2½x3-inch engine have power enough to drive a pair of twin screws 12 inches in diameter? What pitch should the screws be, and how fast should they run? I wish to put the engine between the two shafts and drive with a chain. Can I do it? *A.*—We do not favor driving the propellers with a chain; it may lead to considerable trouble and annoyance. For the desired light draught we believe that twin screws will make the machinery too heavy; we prefer one propeller. A 2½x3-inch engine will give ample power—a smaller engine will

answer the purpose. We should adopt the following dimensions: Length of boat, 18 feet; width, 4 feet 6 inches; depth, 2 feet. Diameter of cylinder, 2 inches; stroke, 3 inches; number of revolutions, 450; diameter of propeller, 12 inches; pitch, 21 inches; diameter of shaft, 1 inch.

(453) Reader, Philadelphia, Pa., asks: 1. Does the power of the main spring in a watch vary? *A.*—Yes. 2. Why? *A.*—Because the tension of the spring decreases as it unwinds. You may satisfy yourself as to the correctness of this statement by noticing the difference in power required to wind up a watch or clock which has completely run down. 3. What are the correct relative positions of the plan, front and side elevation of an object? *A.*—This has been explained in the articles on Practical Drawing, now running in the AMERICAN MACHINIST. See our issue of February 11, 1888.

(454) J. N. B., Cumberland, Md., asks: Do you know of any book that would enable me to arrive at the conclusions of problems, such as are given in Haswell's and other engineering books, without so much side figuring, or, in other words, to aid one who is deficient in mathematics without going to the trouble of going back and learning the rules; it is that which I have to do now, and do not always have the time to do so. For instance, how many men can dig a trench 135 feet long in eight days when 16 men can dig 54 feet in six days? Now, the only way I can arrive at the answer is to take any old school arithmetic and study the rule until I am able to master it. Now I would like to know if there is anything that will enable me to do this easier. *A.*—The only correct and shortest way to arrive at the answer is the one you say you are compelled to take. If you will spend a little time in studying arithmetic, and not attempt to commit the rules simply to memory, but search for the principles upon which the rules are based, and understand these principles, you will soon be able to throw the arithmetic aside, and solve such simple problems by the shortest and most satisfactory methods, without the aid of books. We do not know of any other book than a good common arithmetic that will aid you; if other books are recommended, do not put any faith in them; there is no royal road to learning.

(455) G. M., Naugatuck, Conn., writes: Please tell me where, in New York, I must apply for a stationary and marine engineer's license, and what will be the charge for the same? *A.*—For a stationary engineer's license apply at the office of the inspection of steam boilers, Police Department, 300 Mulberry street, New York City. For a marine engineer's license apply at the office of the U. S. Supervising Inspector of Steam Vessels, Post Office Building, New York city. No fee is charged for the examination or license. 2. Can a stationary engineer obtain a marine engineer's license without having had experience on a boat? *A.*—No. The following rule is printed on the back of a stationary engineer's certificate: When, on an examination of an applicant, it appears to the satisfaction of the engineers that he lacks natural capacity or mechanical skill, knowledge or experience, or is unfitted by habits of insobriety to perform the required duties in a manner consistent with safety to life, a certificate of qualification will be denied. Renewals of certificates will be refused, and certificates will be revoked on proof of like deficiencies. The general rules and regulations prescribed by the Board of Supervising Inspectors of Steam Vessels, relating to the granting of marine engineer's license, have been given in answer to Question 361, in our issue of September 26, 1889. By comparing these rules you will find that qualifications required of an applicant for a marine engineer's license differ from those required for a stationary engineer's license.

(456) R. J. G., Providence, R. I., writes: Please inform me as to whether—in your opinion—there are more openings for an ambitious young man in the engine or cotton machine shops than in tool shops. I served my apprenticeship in a tool shop, and have continued to work at this business for about six years. I have attended drawing school three seasons. It seems to me that there is more science in heavy work than puttering about tool making. Men seem to get to a certain stage and then stick there. Do you think a man would derive any great benefit from experience in English shops? And what course would you pursue if you were wholly without friends whose influence would help you? *A.*—We believe that there are as many openings for a good tool maker as there are in any other business. But, if the building of steam engines or other heavy work is more to your taste, we should advise you to seek employment in those shops. But you must not expect to rise in any business if you simply putter about; you must put forth your whole energy to learn every branch of the business, and devote your spare time to study, even if there are no prospects for an immediate advancement. Patient, energetic and faithful application to business and study is sure to have its reward in time. Young men will certainly be benefited by a reasonable amount of travel in this or foreign countries; they will come in contact with first-class mechanics, and cannot help to gain experience, and will also recognize their own deficiencies, provided they are not above learning. Young men who are determined to learn can and should rise in their profession without the influence of friends. Our advice to you is to do your duty faithfully both to yourself and your present employer, and watch for favorable opportunities to make a change for the better.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc., J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells, & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Prestoline & Prestoline Paste, for cleaning & polishing metals. S. A. Smith, 23 S. Canal st., Chicago.

Iron Planers from 16" to 36" wide by any length. H. C. Pease & Co., Worcester, Mass.

R. G. Du Bois, 715 11th St., Washington, D. C. Procures first class patents on inventions. Write.

Milling Machines. Pedrick & Ayer, Philadelphia, Pa.

Universal Grinding Machine. Pedrick & Ayer, Philadelphia, Pa.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

For Portable Key-seating Machines and Stub Ends for small connections, address T. C. Dill Machine Co., 726 Girard ave., Philadelphia, Pa.

Solid Bolt Dies, V, U. S. S., Whitworth, Square and Left-Hand Threads in stock. S. W. Card & Co. Mansfield, Mass.

25" 28" 32" 36" Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages. Illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

Standard Reducing Valve, Standard Pump Pressure Regulators, Improved Collignon Cylinder Oil Pumps, Jenkins Globe and Angle Valves. Send for circulars. Standard Regulator Co., 70 Elm st., Buffalo, N. Y.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller.
Propellers of same pattern and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices.
Consulting Expert and Constructing Engineer.
Estimates made on machinery and on damages.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2. postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Dec. 5, 1889 issue, 91 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 105 articles have thus far appeared up to and including the November 28, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

C. H. De Lamater & Co. have closed their extensive manufactory at the foot of West 13th street, New York, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.
In order to close out the remainder of the stock, offer for sale a very desirable lot of machinery, such as lathes from 15" to 88" swing, planing machines 48"x45"x10', 53"x50"x12', 17"x14"x24', 72"x69"x24', and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.
Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers and two 8"x16" and one 10"x20" Rider cut-off engines.

MANUFACTURES

Zeisler & Son, Lacrosse, Wis., contemplate building a paper mill.

Robert Leamon is interested in building car works at Owensboro, Ky.

Kerr & Stout will build a machine shop and foundry at Danville, Va.

The Troy (Ala.) Iron Works will add several machine tools to their plant.

J. A. Barnes, Oshkosh, Wis., is building a new foundry and machine shop.

The Racine (Wis.) Bolster Spring Co., are building works at Racine Junction.

A. M. Dexter is building an addition to his machine shop at Mattapoisett, Mass.

R. F. Driver will build a foundry at Anderson, S. C. He already has a machine shop.

The Alabama Lumber Co. will build a sash, door and blind factory at Fort Payne, Ala.

The Chesapeake Knitting Mills Co. will build a mill to employ 150 hands at Beverly, Va.

J. W. Joyce & Co., carriage manufacturers, of Lawrence, Mass., will build a new shop.

The Advance Thresher Company, Battle Creek, Mich., are making large additions to their works.

The Norton Emery Wheel Co., Worcester, Mass., are building an addition to their works, 48x58 feet.

The Hattu-Ensley furnace at Sheffield, Ala., will be blown in as soon as sufficient stock has accumulated.

The Mascoma Flannel Co., of Lebanon, N. H., will enlarge its plant so as to increase its production 50 per cent.

The S. E. Brown Heating Co. has been chartered at Chicago, Ill. Heating apparatus will be manufactured.

Charles R. Harris, of Attleboro, Mass., will build a shop for manufacturing jewelry at North Windham, Conn.

The Bethlehem Iron Company's blast furnace at Bingen, Pa., has been blown in, after an idleness of over a year.

Geo. Frank will open the Geo. Page & Co. machine shops at Baltimore, Md., which have for some time been closed.

The Eckerson Printing Press Co. will soon erect suitable buildings for manufacturing purposes at Oneonta, N. Y.

The Concord Woolen Mills at Smyrna, Ga., will rebuild the mill recently burned, making it twice its former capacity.

M. S. Stevens is interested in organizing a stock company to manufacture farm machinery and vehicles, at Duluth, Minn.

The Vitrified Wheel Company, Westfield, Mass., has reorganized, with a capital stock of $60,000. William C. Clark is president.

The Hill Automatic Sprinkler Co., Columbus, Ga., who recently found it necessary to enlarge their works, will again double their capacity.

A charter has been granted to Hecla Iron Company, Pittsburgh, Tenn. The directors are: E. H. Smith, C. S. Crawford and C. C. Morrow.

W. J. Dean, C. C. Webber, O. B. Kinnard and Albert Haines, have organized the Kinnard Hay Press Company, to manufacture the Kinnard & Haines hay press, at Minneapolis, Minn.

The McConway & Torley Co. iron founders and machinists, Pittsburgh, Pa., are building an extension to their works, 115x210 feet. The extension will be used as a machine and blacksmith shop.

The Sebastian May Co., Cincinnati, Ohio, have issued a very complete catalogue of machinery, tools and supplies. They manufacture and sell a large line of belted machine tools, and machinists' small tools.

The Spiral Weld Tube Company, of East Orange, N. J., are now considerably more than doubling their mill capacity. They have under contract for delivery before February 1, machines which will turn out 7,150 feet per day.

The Central Railway Supply and Construction Company has been incorporated at Indianapolis, Ind., to manufacture and deal in all kinds of railroad supplies, equip railways and street railways. The capital stock is $50,000. Directors, John E. McGettigan, Frank S. Foster, Lewis P. Horton, Frank A. Lapham and Ephraim C. Dawes.

The Richmond (Va.) Ice Machine Company has been incorporated with Herman Schmidt, president; Wm. Simpkin, vice-president, and E. A. Catlin, secretary and treasurer, to manufacture ice machinery.

Sterling Elliott, Newton, Mass., is building a new shop alongside of his old one. The new shop is 31x60 feet, four stories high. The new building will be used for building bicycles. Mr. Elliott reports his general business as good.

H. D. Penney, New Gloucester, Me., has recently brought out a tool for measuring the allowance for shrink fits, and for similar purposes. It is said to be a very simple tool, consisting of but three parts, and measuring to $\frac{1}{4000}$ of an inch.

The Chulasky furnace, at Chulasky, Cumberland Co., Pa., that has been idle for several years, is being put in order by Jas. D. Kase, of Danville, and will go in blast the 1st of January, 1890. This furnace has an annual capacity of 6,500 tons.

There is water-works agitation at Lexington, Ky.; Burlington, Wis.; Van Wert, Ohio; Miamisburg, Ohio; Sea Island City, N. J.; Rock Rapids, Ia.; Hull, Ia.; Elk Rapids, Mich.; Lake City, Cal.; Coldwater, Mich.; Asbury Park, N. J.; Excelsior, Minn.

The Newark Machine Tool Works, Newark, N. J., have issued a catalogue descriptive of horizontal boring and drilling machines made by them. In addition to cut and description of their machine, there is a chapter discussing the utility of boring machines.

Rathbone, Sard & Co., of Albany, N. Y., have their plans complete for their new foundry at Aurora, Ill. They will build a foundry, 150x280 feet; a mounting shop, 75x185 feet, three stories high; a scratch shop, 50x72 feet, and a warehouse, 95x212 feet.

The Cartwright Manufacturing Company, of Louisville, Ky., has been organized, to build a wagon factory. A. B. Davis will be president, W. C. Nones, vice-president; J. B. Baskin, secretary, and F. Cartwright superintendent. The capital stock is $100,000.

Bradford & Morton have purchased the carriage factory of Waters, Sampson & Co., at Plymouth, Mass., and will convert it into a factory for the making of insulated conducting wire. An engine is to be put in and the building is to be remodeled for its new purposes.

We have received from the John T. Noye Manufacturing Co., Buffalo, N. Y., New York office 89 Liberty street, a catalogue of the Rice automatic engine, as made by the company named. The catalogue is very fully illustrated, showing engines both simple and compound.

Jennings Bros. & Co., of the West Penn Steel Works, at Leechburgh, have decided to move the steel making portion of their plant to Allegheny City, Pa., and, by January 1, they hope to have their 12-ton Siemens-Martin open-hearth furnace in operation. The rolling mill will remain at Leechburg.

At a meeting of oil-well tool manufacturers at Oil City, Pa., recently, an organization to regulate prices was formed. The membership of the new organization, it is stated, includes nearly all the manufacturers of drilling tools, etc. The idea is said to be to advance prices slightly, and make all prices and discounts uniform.

The Sharon *Herald* says: For some time past negotiations have been quietly in progress whereby Messrs. Fayette and Harvey H. Brown, D. W. Chambers and R. W. Hickock, of Cleveland, and Hon. Samuel McClure and Mr. E. W. Budd, of this town, have purchased a controlling interest in the Stewart Iron Company's plant in this place [Sharon, Pa.,] and in its coke ovens and coal lands at Uniontown, Fayette county. The iron plant here is a large, well-equipped and valuable one. It comprises 46 acres of ground in the southern part of the borough. Four acres of it are occupied by a rolling mill, 60x336 feet in size, two blast furnaces, two casting houses, machine, blacksmith and carpenter shops, stock house, office, etc.

The Springfield Glue and Emery Wheel Co. have lately increased their paid-up capital stock from $20,000 to $150,000, and elected a new board of officers, and changed their name to Springfield Emery Wheel Manufacturing Co. The new company have secured about three acres of land at Bridgeport, Conn., where they will have their own docks and side track from the N. Y., N. H. & H. R. R. right to their factory. Contracts have been let for a main brick building, 300x50 feet, two stories and a half high, which will be used for machine shop, and for the manufacture of sapphire, flint and emery paper and emery cloth. The emery wheel department will be located in brick building, 100x80 feet, one story high. The pattern shop will be fireproof, 50x30 feet. Engine and boilers have been purchased for 125 horse-power. Buildings will be heated by the Sturtevant system of hot air, and lighted by electricity. Considerable new machinery has and will be bought, to enable them to keep up with orders. The company expect to have, when completed, the largest and best shop for their line of business yet built. They expect to move about February 1st, and until then will remain at Springfield, Mass.

Machinists' Supplies and Iron.

NEW YORK, Dec. 7, 1889.

Iron—American Pig.—Prices for current deliveries remain as quoted last week, and there is considerable uncertainty as to prices for 1890, as they depend mainly upon the action of the Thomas Iron Co. No. 1 X Foundry brings $19 to $20; No. 2, $18 to $19.

Scotch Pig.—Prices are very irregular, generally speaking. The leading brands have sold from $26.50 to $27.50; inferior brands, $24 to $24.50. There is not enough doing, however, to make fair quotations from.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Competent agents wanted to represent a meritorious & paying steam specialty. Business, AM. MACH.

Foreman and contractor wanted, who can handle men and do good work promptly. Address Steam Engine, care AMERICAN MACHINIST.

Wanted—Draftsman that understands traction engine and saw-mill work. Address Ritchie & Dyer Co., Hamilton, Ohio.

Wanted—Good agents to sell on commission the Combination Pump and Heater. See ad. with cut of the machine. D. E. Rice, Detroit, Mich.

Wanted—Practical foreman, good mechanic, for manufacturing drills, reamers, taps and small tools. Address Box 40, Chester, Pa.

Situation wanted by a Stevens Institute graduate as draftsman in marine engine works. 3 years' exp.; moderate salary; 1st-class refs. Marine, AM. MACH.

Wanted—Foreman boiler works who can manage about 25 men and get out good work at lowest cost. Address A. J. P., AMERICAN MACHINIST.

Drop die sinker wanted. First-class man only. Give experience, age and price. Wyman & Gordon, Worcester, Mass.

Machinists Wanted—Vise hands accustomed to first-class work. Steady employm't and liberal wages guaranteed. Have largely increased our plant and need more men. Niles Tool Works, Hamilton, O.

Wanted—Foreman for blacksmith shop and ass't foreman for foundry. None but men alive to improved methods need apply. State experience and salary expected. Box 58, AMERICAN MACHINIST.

Wanted—Foreman for a wire cloth factory. A practical machinist with experience in handling men. State age, exp., present employment, and give refs. Address Wire Cloth, care AM. MACHINIST.

Wanted—Good mechanic in wood and iron, with $1,000, to take charge of my factory making washing machines and drying closets for steam laundries, also some repairing. State wages wanted, Lock Box 620, Geneseo, Ill.

Educated young man, is an experienced draftsman and machinist, wishes position as draftsman; will work in shop part of time. Can take charge of small shop and do the designing. Address C. F., Lock Box 65, Anamosa, Iowa.

Wanted—Man to take charge of office. Must speak German, and be acquainted with the machine business, especially with the systematic keeping of cost accounts. Address, stating qualifications, exp. and expectations, Wood-working Mach'y, AM. MACH.

Wanted—A first-class foreman for small foundry. Must understand casting brass castings. Foundry in first-class shape; heated by steam. Address, with ref. and price per day (for the right man a permanent position can be obtained), E. K. Hayes, Galva, Ill.

Wanted—A competent foreman for mach. works; must be skilled in general designing, construction and iron work, and thoroughly accustomed to the handling of men, together with executive ability. The best refs. given and expected. State wages wanted, and address Foreman, AMERICAN MACHINIST.

Wanted—A thoroughly competent and experienced man to take charge, as superintendent, of a general foundry and machine shop employing from 150 to 200 men, in one of the best towns of 20,000 inhabitants in the West. Must be a good disciplinarian, and thoroughly familiar with the most modern machine shop practice, and capable of taking full charge of all departments of the business. First-class references required. Address Hill, Clarke & Co., 156 Oliver st., Boston, Mass.

Wanted—A 2nd-hand steam hammer, 500 to 700 lbs. Address Hammer, AMERICAN MACHINIST.

For Sale Cheap—8 H. P. Clerk gas engine; little used; in good order. C. S. Brown, Superintendent, Terre Haute, Ind.

A small, well-equipped machine shop wants something to manufacture. Correspondence solicited. Address Box 45, N. Bennington, Vt.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O Box 1262, Phila., Pa.

For Sale—One Jones & Lamson No. 8 Turret Screw Machine. Very little used. Cleveland Motor Co., 241 Center st., New York.

For Sale—An established mach. business, protected by valuable patents. Can be much enlarged by judicious management. C. M. W., AM. MACHINIST.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

For Sale One large Sturtevant blower, capacity equal No. 10. Will exchange for smaller size. One latest improved New Haven Mfg. Co.'s horizontal lathe One 20-light arc dynamo. Address A. L. Ide & Son., Springfield, Ill.

Engineers in overhauling for the New Year will save their employers' money, themselves trouble, and have handsome rods by using the "Selden Packings," which are made either with a rubber core or canvas core; that with the rubber core is especially adapted for steam use. The "Selden" can be obtained from Supply Stores or the man'f'r, Randolph Brandt, 38 Cortlandt st., N Y.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

⅜" Portable Drill, $100. Am. Tool W'ks., Clev. O.

Koopman's Scales for quick measurements.

Glass Triangles. F. E. Harthan, Worcester, Mass.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

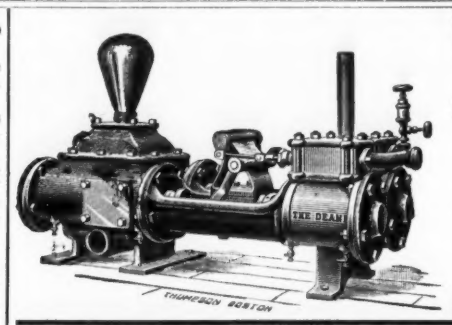
Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Wanted—Patents of merit to manufacture and introduce. BOX 46, AMERICAN MACHINIST.

Wanted—Light mach. work and spec. to manu fac., on contract. Electric Mfg. Co., Greenbush, N. Y.

Small foundry and machine shop for sale. A good thing cheap. Address L. W. Shafer, York, Pa.

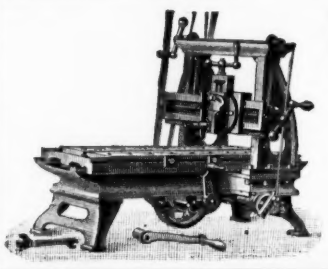


THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

"CRESCENT EXTRA"
Is now used by many of the largest and most carefully managed shops for all **Lathe and Planer Tools, Punches, Dies, Taps, Reamers, &c.**
This steel is famous for its uniformity and great endurance, and should be specified by Machinists and Tool-makers who want the best stock for their tools.
CRESCENT STEEL WORKS,
CHICAGO, ILLS. PITTSBURGH, PA. NEW YORK, N. Y

Improved Screw Cutting Foot and Power LATHES
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
THE SEBASTIAN-MAY CO., 167 W. 2d St.,
CINCINNATI, O.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

TOBIN BRONZE
Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
Anti-Frictional and Non-Corrosive.
CAN BE FORGED HOT.
Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Ingot metal for car and engine bearings. Spring wire.
ANSONIA BRASS & COPPER CO.,
Sole Manufacturers.
Send for Circular. CHICAGO. NEW YORK.



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FOR ANY SMALL WORK.
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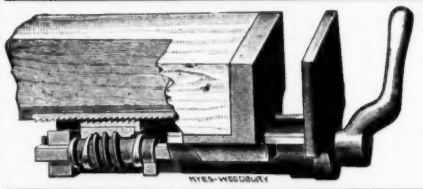

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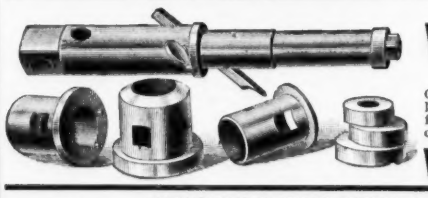

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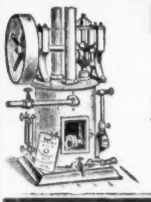

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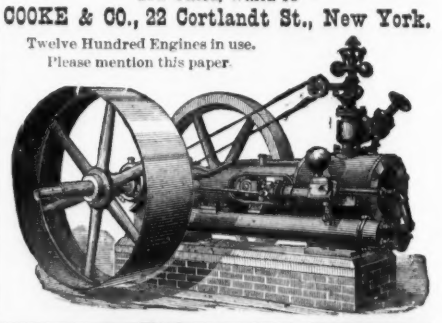

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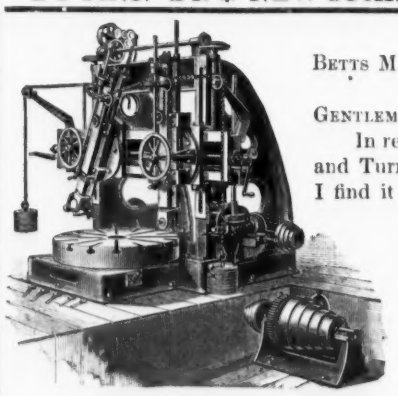

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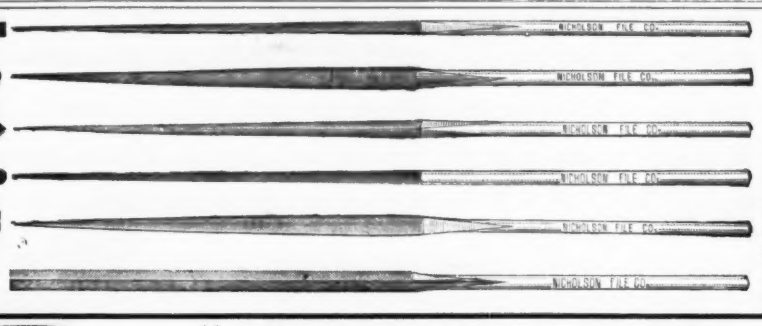

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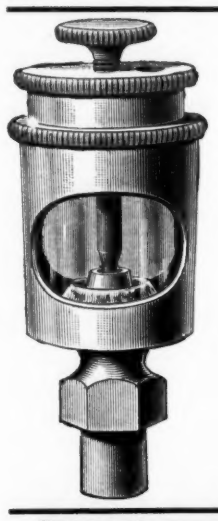

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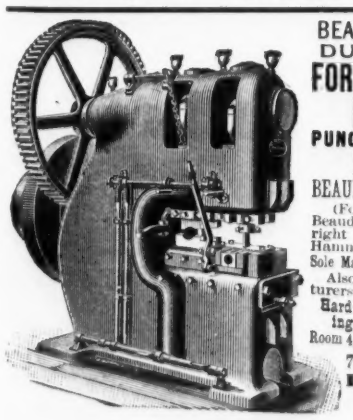

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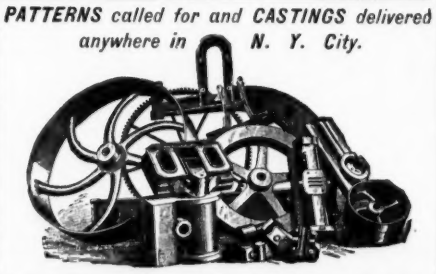

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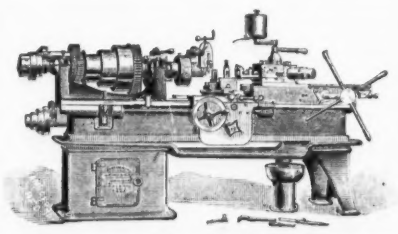

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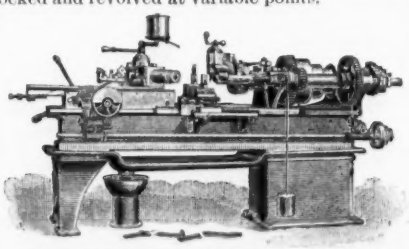

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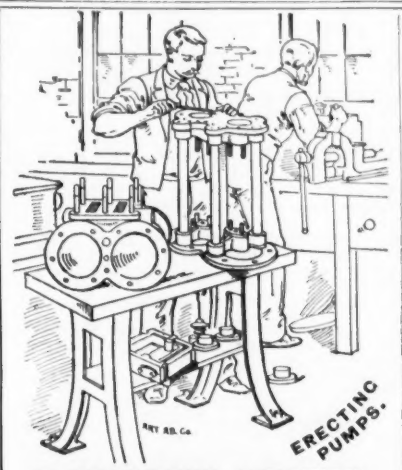

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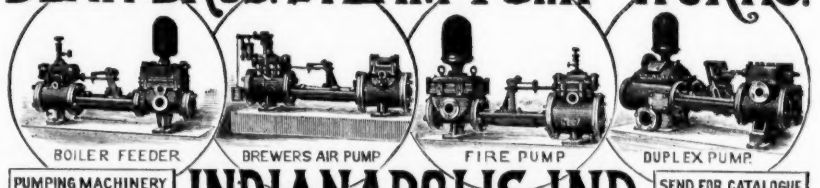

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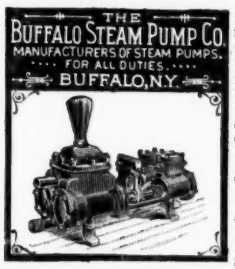

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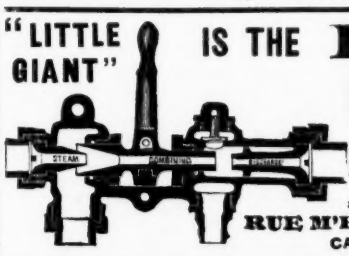

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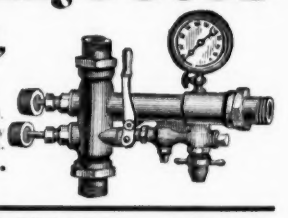

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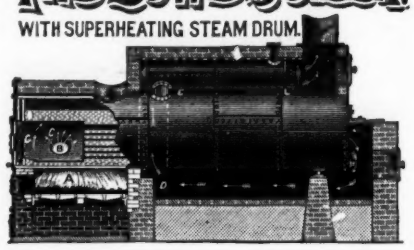

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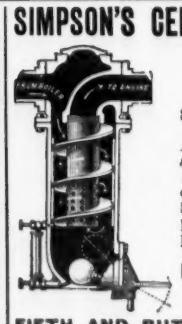

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16 in.	18 in.
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24 in.	30 in.
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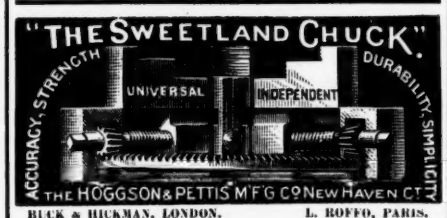

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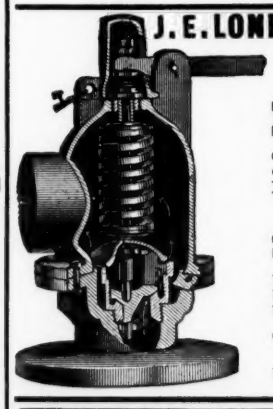

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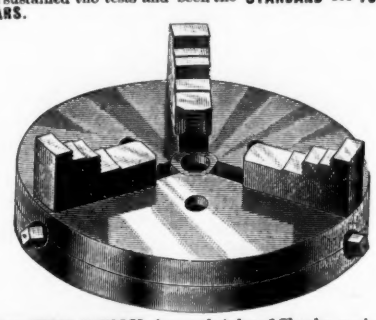

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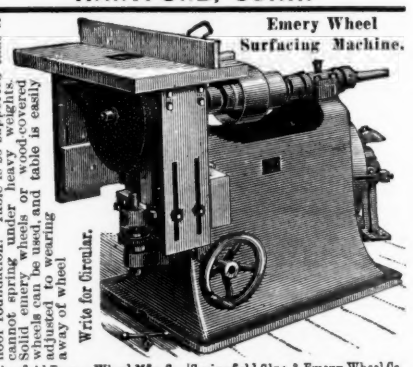

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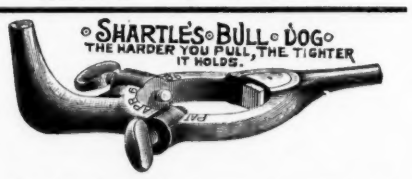

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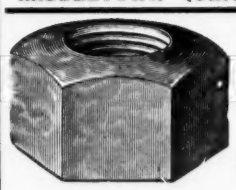

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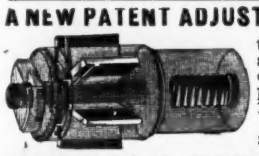

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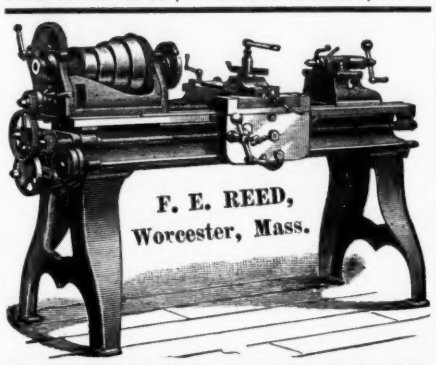

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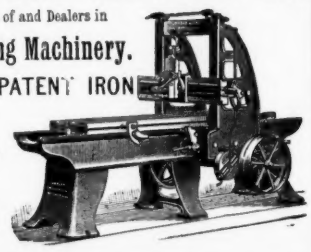

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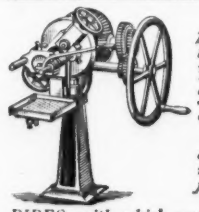

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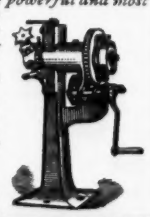

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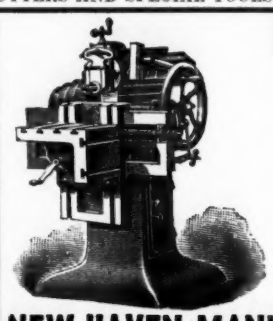

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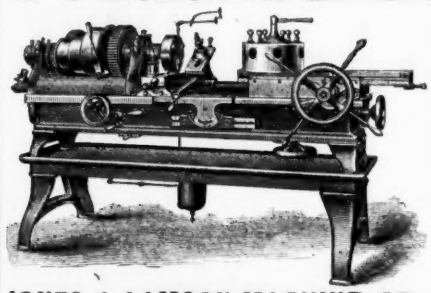

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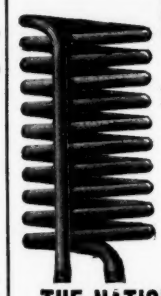

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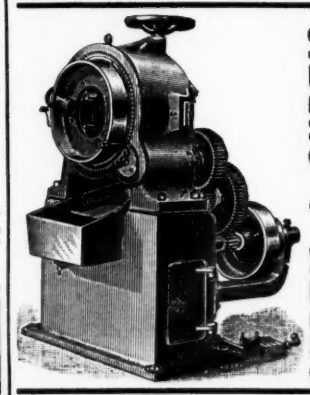

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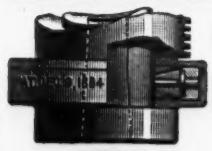

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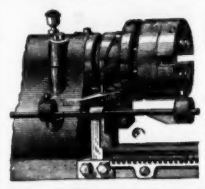

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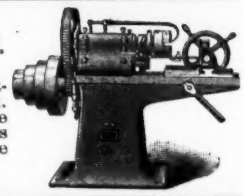

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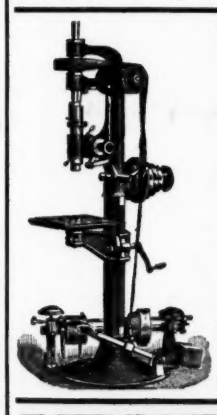

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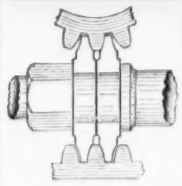

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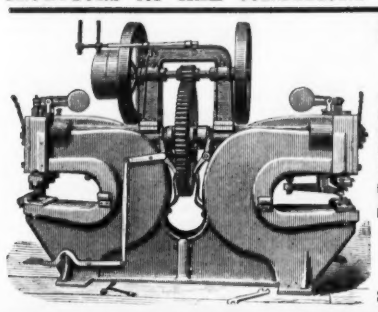

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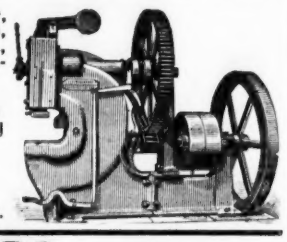

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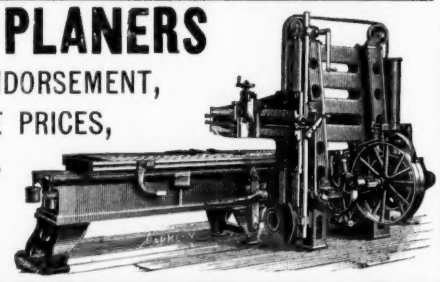

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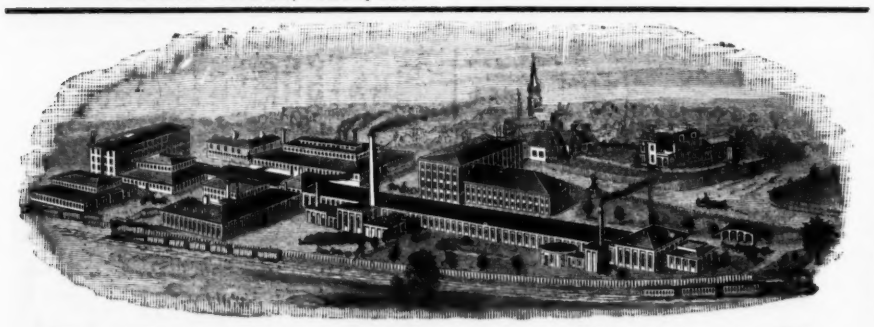

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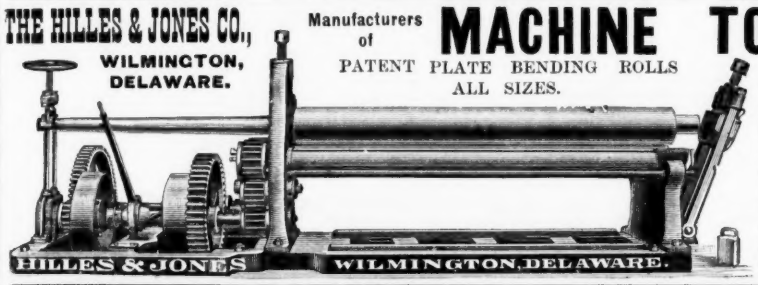

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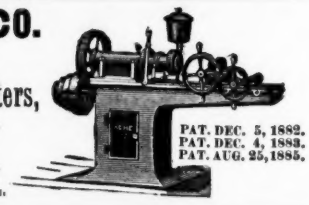

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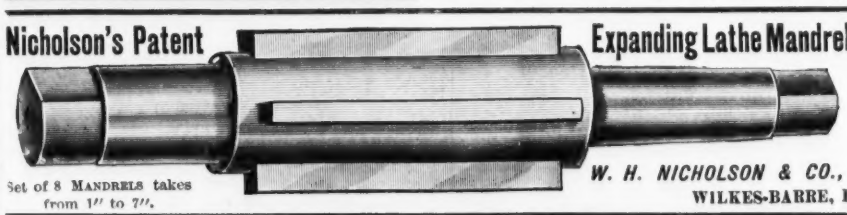

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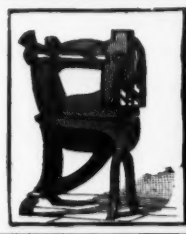

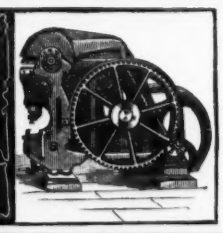

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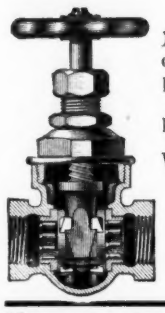

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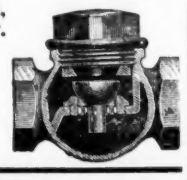

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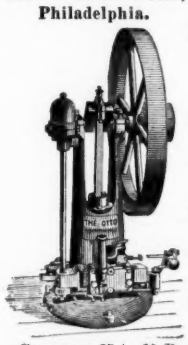

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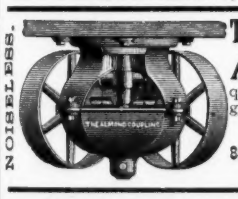

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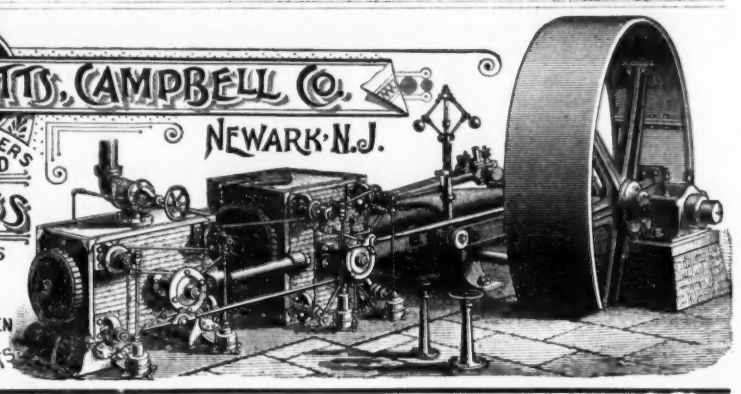

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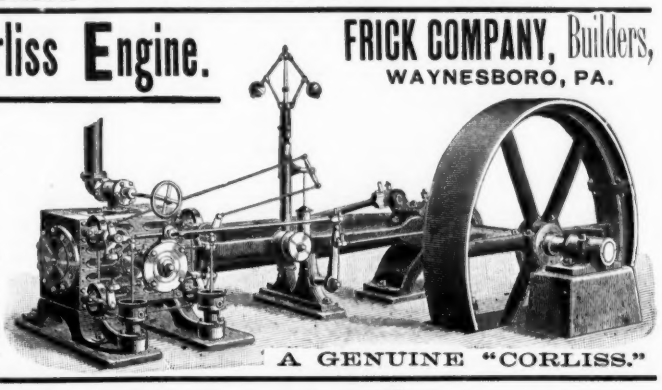

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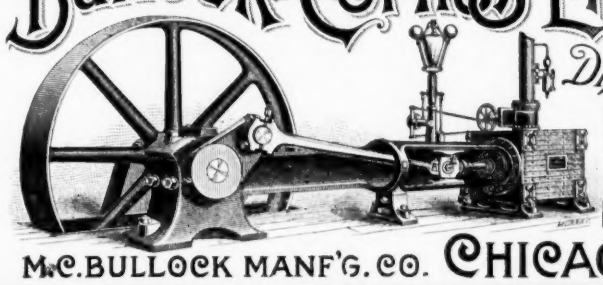

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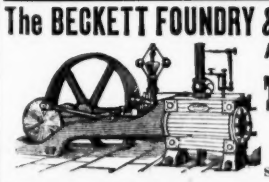

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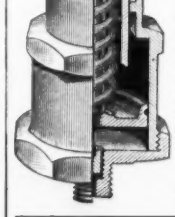

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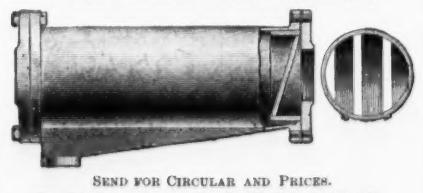

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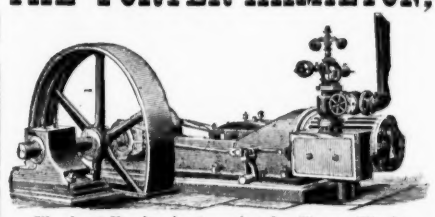

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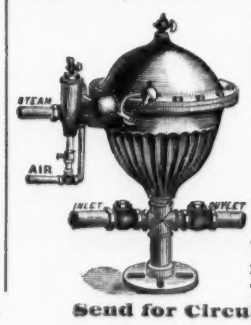

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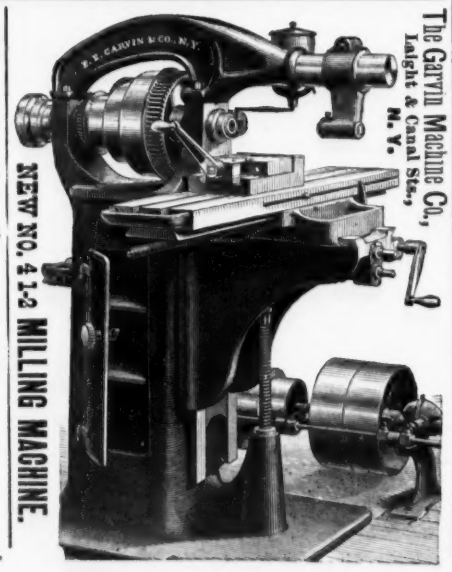

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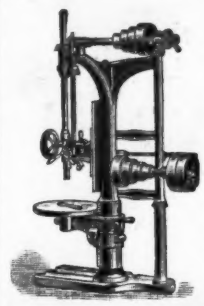

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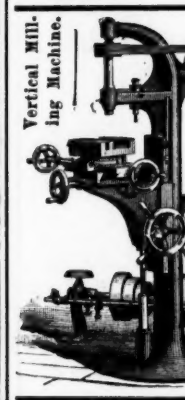

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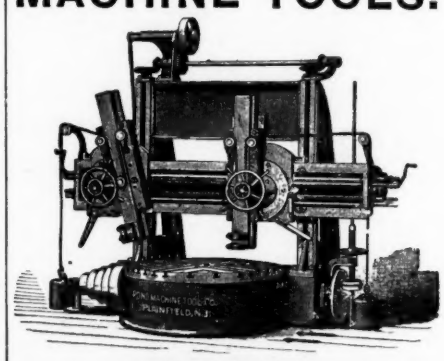

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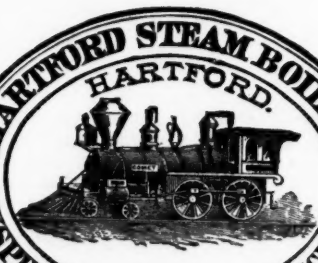

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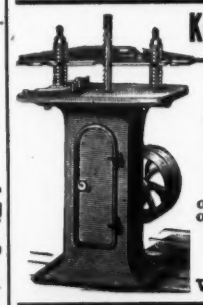

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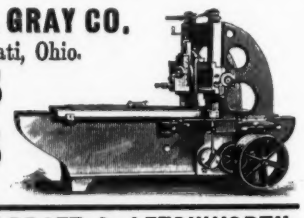

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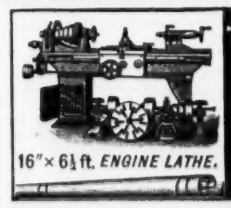

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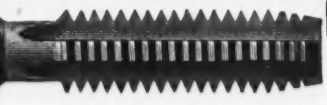

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